US009170802B2

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Nagai et al.

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(54) **METHOD AND INFORMATION PROCESSING APPARATUS FOR EXTRACTING SOFTWARE CORRECTION PATCH FOR VIRTUAL MACHINE**

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(73) Assignee: **FUJITSU LIMITED**, Kawasaki (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G06F 9/44 (2006.01)
G06F 9/455 (2006.01)
G06F 9/445 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 8/65*** (2013.01); ***G06F 9/45558*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 8/65; G06F 9/45533
USPC 717/168–173; 718/1
See application file for complete search history.

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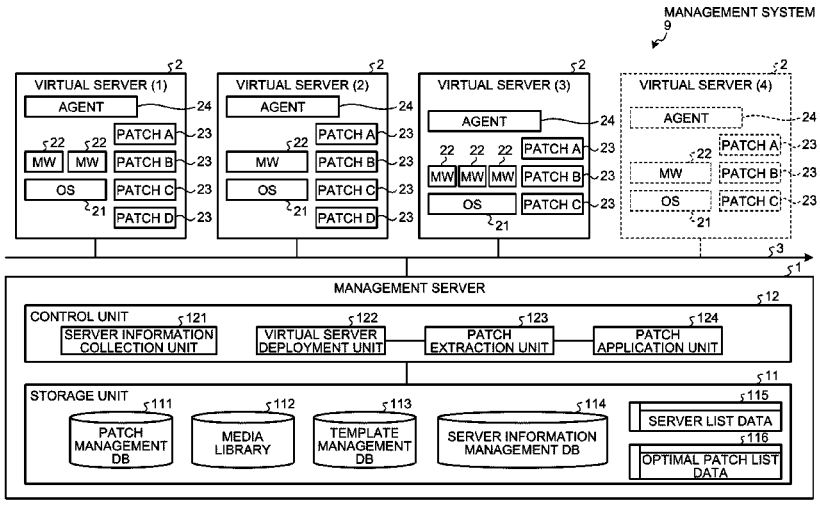
(74) *Attorney, Agent, or Firm* — Fujitsu Patent Center

(57) **ABSTRACT**

A management server refers to a server information management DB that stores therein information on a plurality of virtual servers generated from a plurality of virtual images and information on software that operates on the virtual servers, and selects other virtual server in conjunction with a particular virtual server from the plurality of virtual servers based on information on the particular virtual server generated from a predetermined virtual image and information on software that operates on the particular virtual server. The management server extracts a patch to be applied to the particular virtual server based on patches applied to the other virtual server.

8 Claims, 15 Drawing Sheets



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Zhou et al., "Always Up-to-date—Scalable Offline Patching of VM Images in a Compute Cloud," Dec. 2010, ACM, p. 377-386.*

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FIG.1

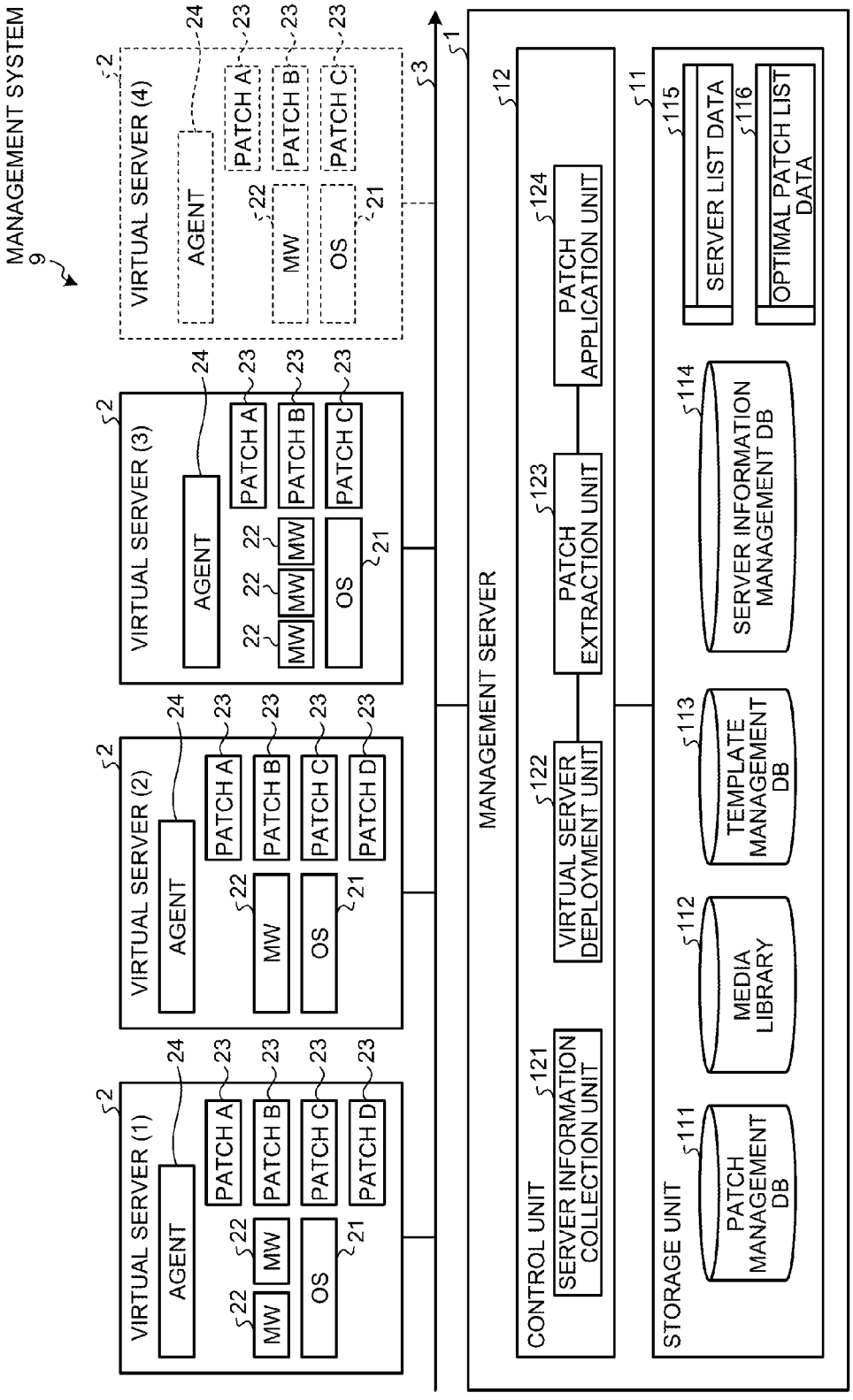

MANAGEMENT SYSTEM
9
MANAGEMENT SERVER
1
CONTROL UNIT
SERVER INFORMATION COLLECTION UNIT
121
VIRTUAL SERVER DEPLOYMENT UNIT
122
PATCH EXTRACTION UNIT
123
PATCH APPLICATION UNIT
124
12
STORAGE UNIT
PATCH MANAGEMENT DB
111
MEDIA LIBRARY
112
TEMPLATE MANAGEMENT DB
113
SERVER INFORMATION MANAGEMENT DB
114
SERVER LIST DATA
115
OPTIMAL PATCH LIST DATA
116
11
3
VIRTUAL SERVER (1)
VIRTUAL SERVER (2)
VIRTUAL SERVER (3)
VIRTUAL SERVER (4)
2
AGENT
24
MW
22
OS
21
PATCH A
PATCH B
PATCH C
PATCH D
23

FIG.2

111

111a PATCH	111b PRODUCT	111c TYPE	111d SUMMARY	111e RELEASE DATE	111f PATCH STORAGE LOCATION
PATCH A	XXXX2008	SECURITY	···	20XX/06/01	/Patch/OS/XXXX/···
PATCH B	XXXX2008	SECURITY	···	20XX/07/01	/Patch/OS/XXXX/···
PATCH C	XXXX2008	IMPORTANT	···	20XX/08/01	/Patch/OS/XXXX/···
PATCH D	XXXX2008	RECOM-MENDED	···	20XX/09/01	/Patch/OS/XXXX/···
PATCH E	XXXX2008	SECURITY	···	20XX/10/01	/Patch/OS/XXXX/···
PATCH F	ABC V2	IMPORTANT	···	20XX/08/01	/Patch/MW/XXXX/ABC·
PATCH G	XYZ V10	SECURITY	···	20XX/09/01	/Patch/MW/XXXX/XYZ·
PATCH X	RHEL6	SECURITY	···	20XX/07/01	/patch/OS/YYYYY/RHEL6/·
PATCH Y	RHEL6	IMPORTANT	···	20XX/08/01	/patch/OS/YYYYY/RHEL6/·
PATCH Z	RHEL6	SECURITY	···	20XX/09/01	/patch/OS/YYYYY/RHEL6/·

FIG.3

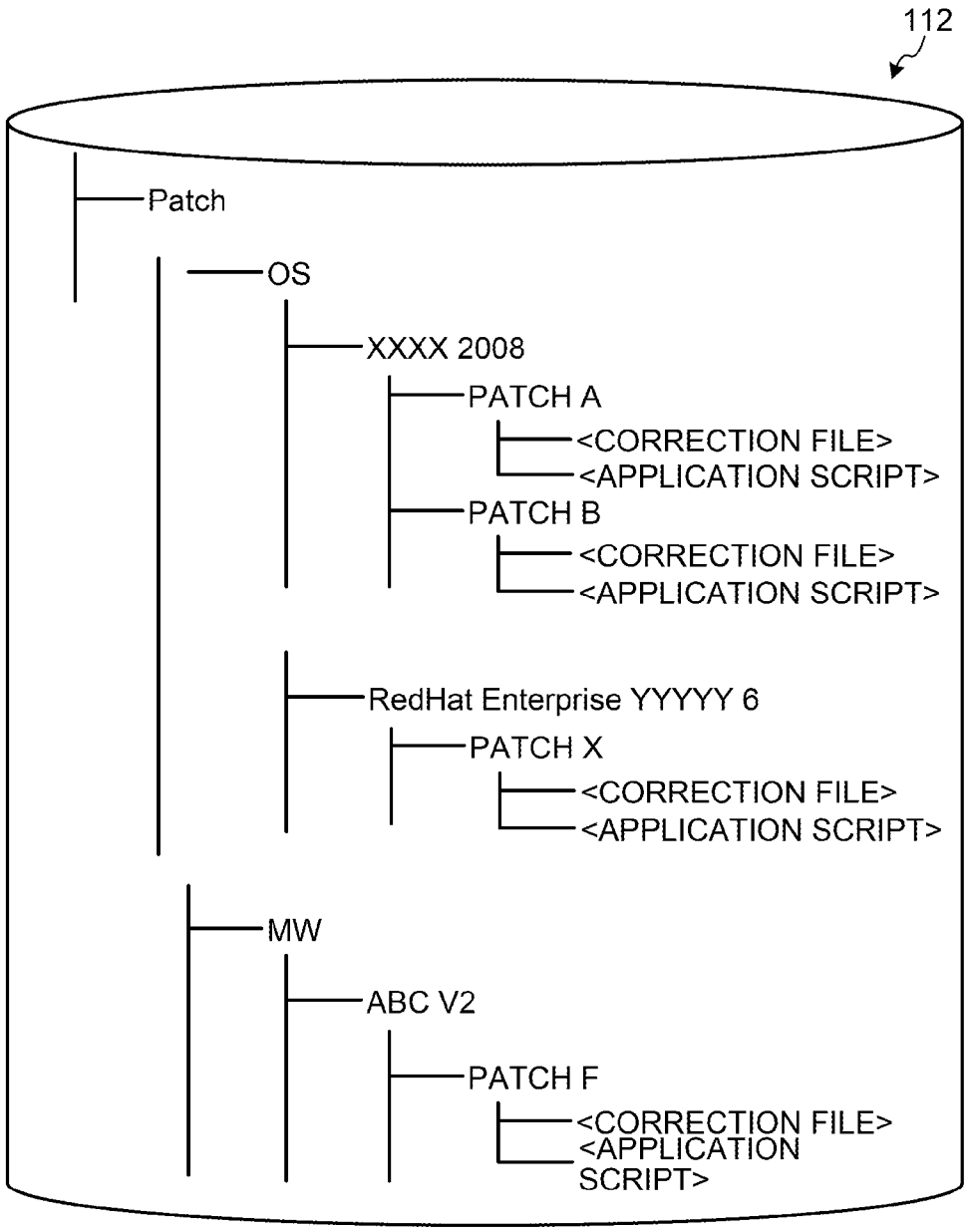
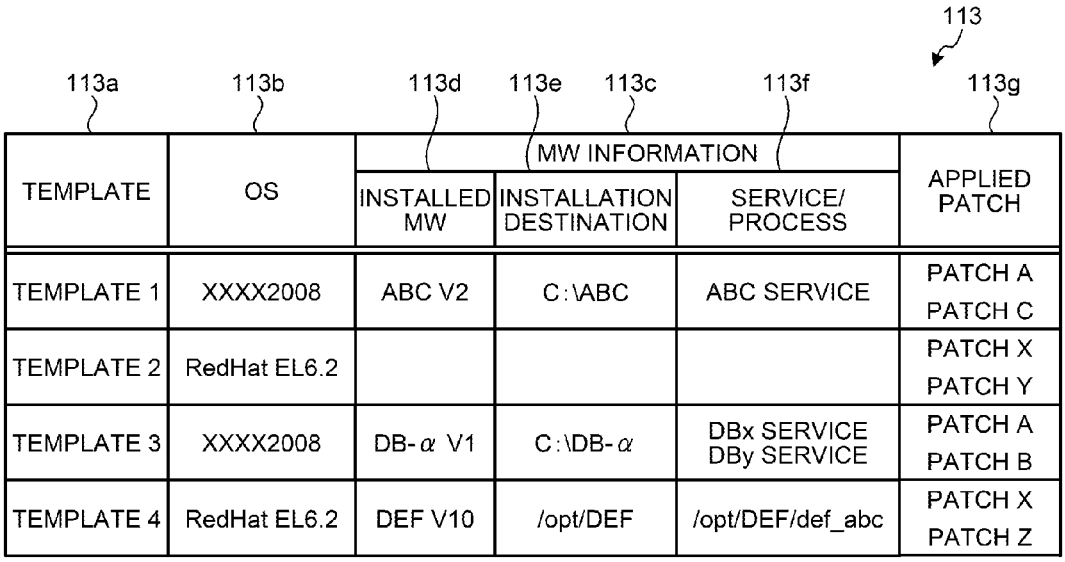

112
Patch
OS
XXXX 2008
PATCH A
<CORRECTION FILE>
<APPLICATION SCRIPT>
PATCH B
<CORRECTION FILE>
<APPLICATION SCRIPT>
RedHat Enterprise YYYYY 6
PATCH X
<CORRECTION FILE>
<APPLICATION SCRIPT>
MW
ABC V2
PATCH F
<CORRECTION FILE>
<APPLICATION SCRIPT>

FIG.4

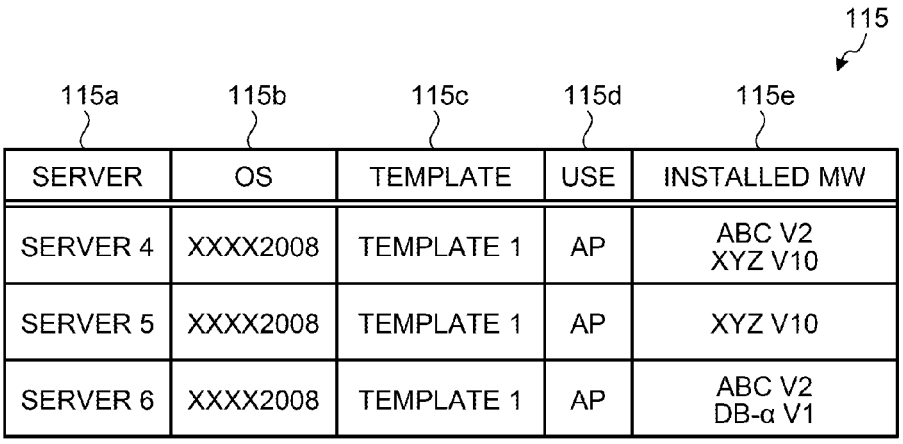


TEMPLATE	OS	MW INFORMATION			APPLIED PATCH
		INSTALLED MW	INSTALLATION DESTINATION	SERVICE/ PROCESS	
TEMPLATE 1	XXXX2008	ABC V2	C:\ABC	ABC SERVICE	PATCH A PATCH C
TEMPLATE 2	RedHat EL6.2				PATCH X PATCH Y
TEMPLATE 3	XXXX2008	DB-α V1	C:\DB-α	DBx SERVICE DBy SERVICE	PATCH A PATCH B
TEMPLATE 4	RedHat EL6.2	DEF V10	/opt/DEF	/opt/DEF/def_abc	PATCH X PATCH Z

FIG.5

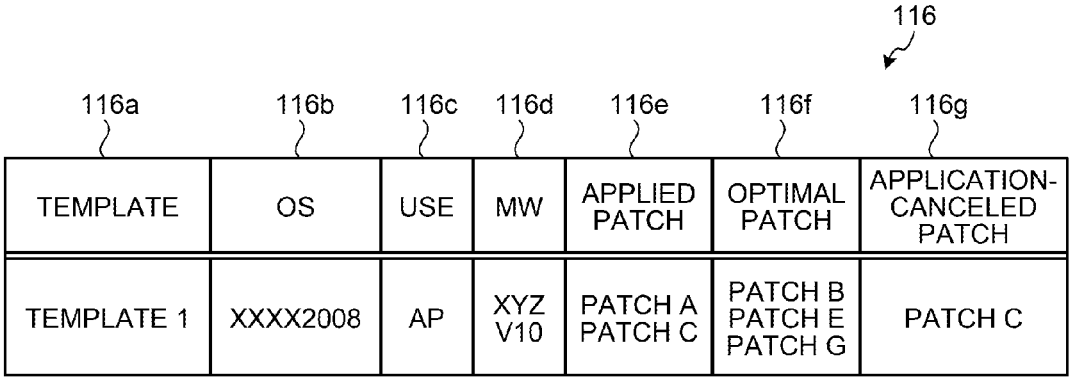
SERVER 114a	OS 114b	TEMPLATE 114c	USE 114d	OPERATION RECORD (LAST CHECK DATE) 114e	OPERATING RATE 114f	MW INFORMATION 114g				LAST PATCH APPLICATION DATE 114l	APPLIED PATCH 114m	DELETED PATCH 114n
						INSTALLED MW 114h	OPERATIONAL STATUS 114i	INSTALLATION DESTINATION 114j	SERVICE/PROCESS (LOG SIZE) 114k			
SERVER 1	XXXX2008SP2	TEMPLATE 1	Web	○ (20XX/10/20)	99.xx	ABC V2	○	C:\ABC	ABC SERVICE (100)	20XX/10/01	PATCH A PATCH B PATCH C	
SERVER 2	XXXX2008SP1	TEMPLATE 1	Web	○ (20XX/10/20)	98.xx	ABC V2	○	C:\ABC	ABC SERVICE (100)	20XX/10/04	PATCH A PATCH B PATCH C PATCH D	
SERVER 3	XXXX2008	TEMPLATE 1	Web	× (20XX/07/20)	99.xx	ABC V2	×	C:\ABC	ABC SERVICE (100)	20XX/07/10	PATCH A	
SERVER 4	XXXX2008SP2	TEMPLATE 1	AP	○ (20XX/10/20)	95.xx	ABC V2	×	C:\ABC	ABC SERVICE (100)	20XX/10/10	PATCH A PATCH B PATCH E	PATCH C
						XYZ V10	○	C:\XYZ	XYZ SERVICE (100)			
SERVER 5	XXXX2008SP2	TEMPLATE 1	AP	○ (20XX/10/20)	99.xx	XYZ V10	○	D:\XYZ	XYZ SERVICE (100)	20XX/10/01	PATCH A PATCH B PATCH C PATCH D PATCH G	
SERVER 6	XXXX2008SP1	TEMPLATE 1	AP	○ (20XX/10/20)	97.xx	ABC V2	○	C:\ABC	ABC SERVICE (100)	20XX/10/10	PATCH A PATCH B PATCH C PATCH E PATCH F	
						DB-α V1	○	D:\DB-α	DBx SERVICE DBy SERVICE (100)			

FIG.6



SERVER	OS	TEMPLATE	USE	INSTALLED MW
SERVER 4	XXXX2008	TEMPLATE 1	AP	ABC V2 XYZ V10
SERVER 5	XXXX2008	TEMPLATE 1	AP	XYZ V10
SERVER 6	XXXX2008	TEMPLATE 1	AP	ABC V2 DB-α V1

FIG.7



TEMPLATE	OS	USE	MW	APPLIED PATCH	OPTIMAL PATCH	APPLICATION-CANCELED PATCH
TEMPLATE 1	XXXX2008	AP	XYZ V10	PATCH A PATCH C	PATCH B PATCH E PATCH G	PATCH C

FIG.8

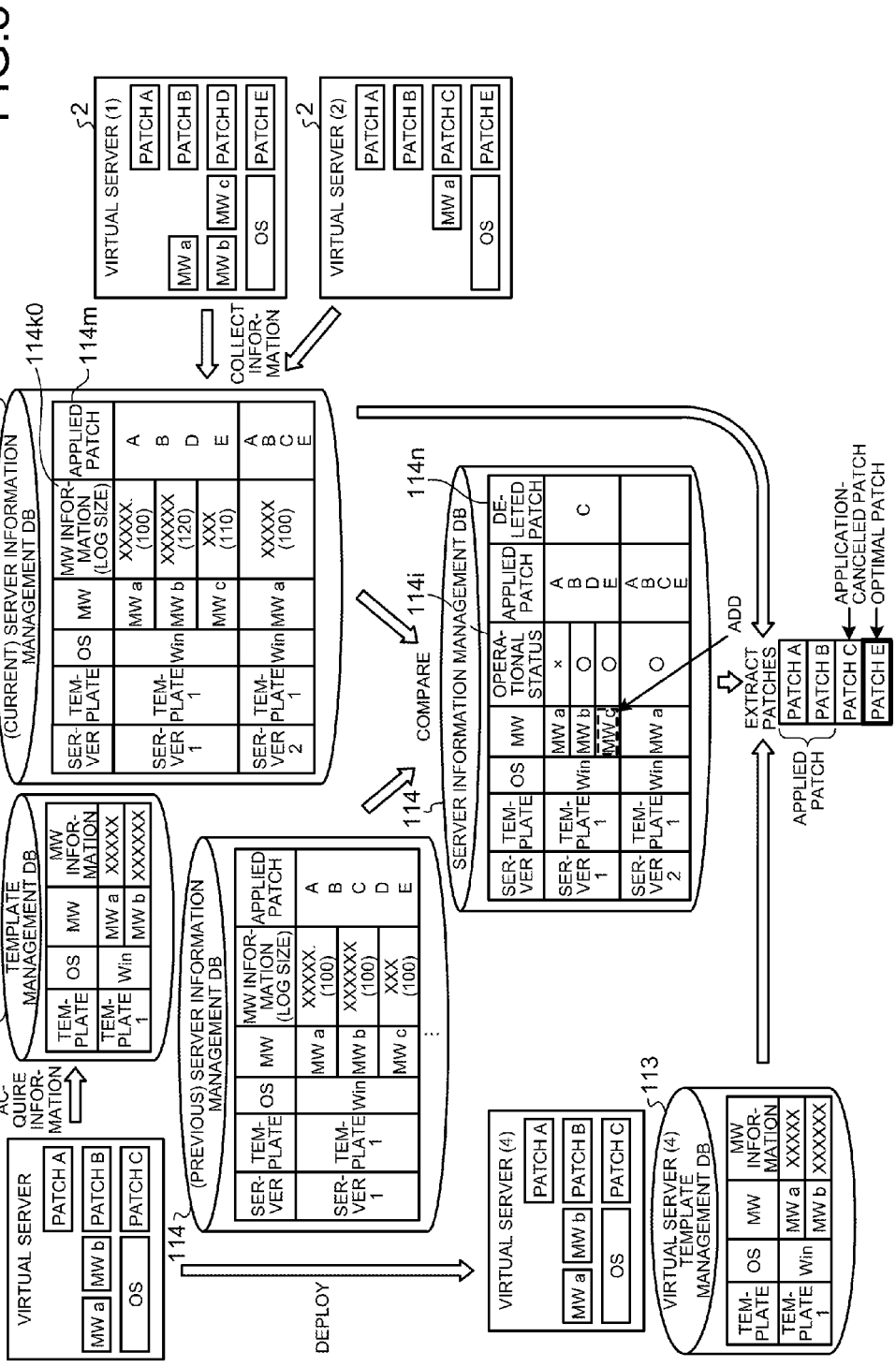

VIRTUAL SERVER (1)
PATCH A
PATCH B
PATCH D
PATCH E
MW a
MW b
MW c
OS
2
VIRTUAL SERVER (2)
PATCH A
PATCH B
PATCH C
PATCH E
MW a
OS
2
COLLECT INFORMATION
114
114k0
114m
(CURRENT) SERVER INFORMATION MANAGEMENT DB
SERVER
TEMPLATE
OS
MW
MW INFORMATION (LOG SIZE)
APPLIED PATCH
SERVER 1
TEMPLATE 1
Win
MW a
MW b
MW c
XXXXX (100)
XXXXXX (120)
XXX (110)
A B D E
SERVER 2
TEMPLATE 1
Win
MW a
XXXXX (100)
A B C E
114n
114i
COMPARE
SERVER INFORMATION MANAGEMENT DB
OPERATIONAL STATUS
DELETED PATCH
SERVER 1
TEMPLATE 1
Win
MW a
MW b
MW c
×
○
○
A B D E
C
SERVER 2
TEMPLATE 1
Win
MW a
○
A B C E
ADD
EXTRACT PATCHES
APPLIED PATCH
PATCH A
PATCH B
PATCH C
PATCH E
APPLICATION-CANCELED PATCH
OPTIMAL PATCH
113
TEMPLATE MANAGEMENT DB
TEMPLATE
TEMPLATE 1
OS
Win
MW
MW a
MW b
MW INFORMATION
XXXXX
XXXXXX
ACQUIRE INFORMATION
VIRTUAL SERVER
PATCH A
PATCH B
PATCH C
MW a
MW b
OS
114
(PREVIOUS) SERVER INFORMATION MANAGEMENT DB
SERVER 1
TEMPLATE 1
Win
MW a
MW b
MW c
XXXXX (100)
XXXXXX (100)
XXX (100)
A B C D E
DEPLOY
VIRTUAL SERVER (4)
PATCH A
PATCH B
PATCH C
MW a
MW b
OS
113
VIRTUAL SERVER (4) TEMPLATE MANAGEMENT DB
TEMPLATE
TEMPLATE 1
OS
Win
MW
MW a
MW b
MW INFORMATION
XXXXX
XXXXXX

FIG.9

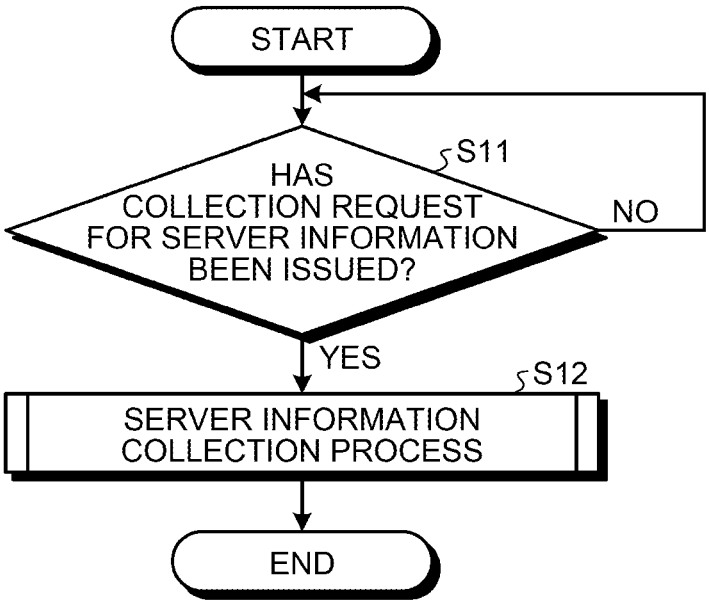

START
S11
HAS COLLECTION REQUEST FOR SERVER INFORMATION BEEN ISSUED?
NO
YES
S12
SERVER INFORMATION COLLECTION PROCESS
END

FIG.10

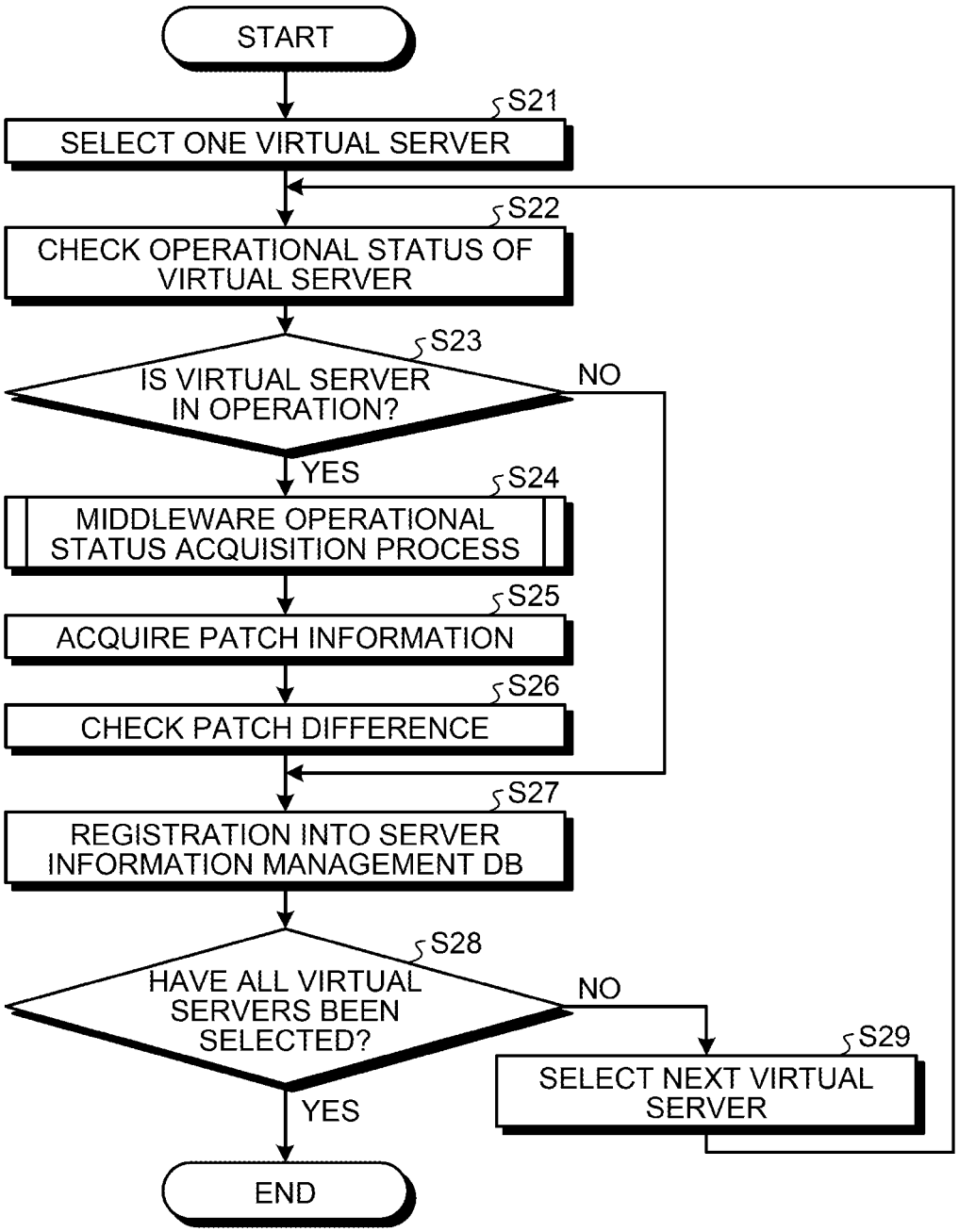

START
S21
SELECT ONE VIRTUAL SERVER
S22
CHECK OPERATIONAL STATUS OF VIRTUAL SERVER
S23
IS VIRTUAL SERVER IN OPERATION?
NO
YES
S24
MIDDLEWARE OPERATIONAL STATUS ACQUISITION PROCESS
S25
ACQUIRE PATCH INFORMATION
S26
CHECK PATCH DIFFERENCE
S27
REGISTRATION INTO SERVER INFORMATION MANAGEMENT DB
S28
HAVE ALL VIRTUAL SERVERS BEEN SELECTED?
NO
YES
S29
SELECT NEXT VIRTUAL SERVER
END

FIG.11

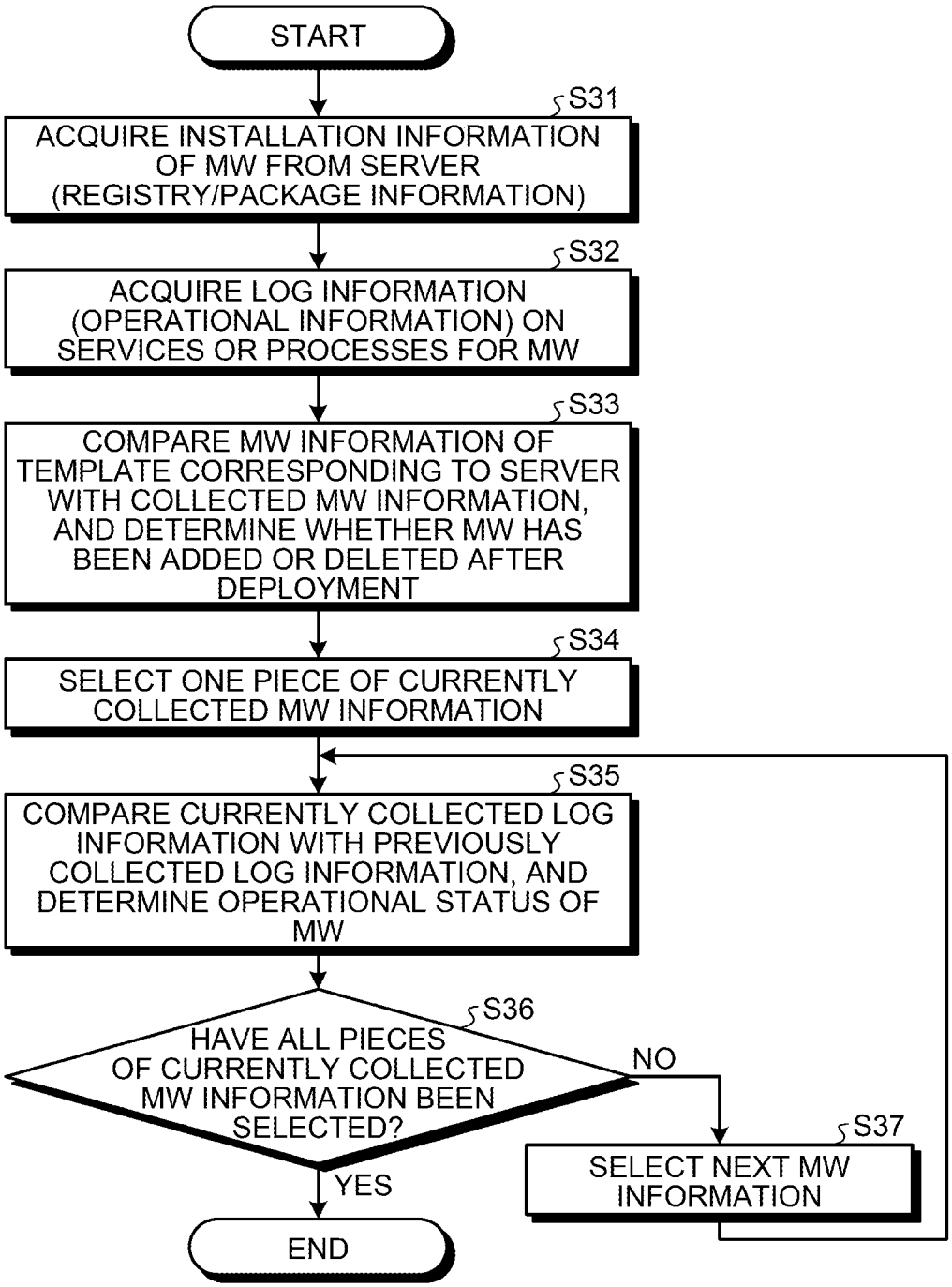

START
S31
ACQUIRE INSTALLATION INFORMATION OF MW FROM SERVER (REGISTRY/PACKAGE INFORMATION)
S32
ACQUIRE LOG INFORMATION (OPERATIONAL INFORMATION) ON SERVICES OR PROCESSES FOR MW
S33
COMPARE MW INFORMATION OF TEMPLATE CORRESPONDING TO SERVER WITH COLLECTED MW INFORMATION, AND DETERMINE WHETHER MW HAS BEEN ADDED OR DELETED AFTER DEPLOYMENT
S34
SELECT ONE PIECE OF CURRENTLY COLLECTED MW INFORMATION
S35
COMPARE CURRENTLY COLLECTED LOG INFORMATION WITH PREVIOUSLY COLLECTED LOG INFORMATION, AND DETERMINE OPERATIONAL STATUS OF MW
S36
HAVE ALL PIECES OF CURRENTLY COLLECTED MW INFORMATION BEEN SELECTED?
NO
S37
SELECT NEXT MW INFORMATION
YES
END

FIG.12

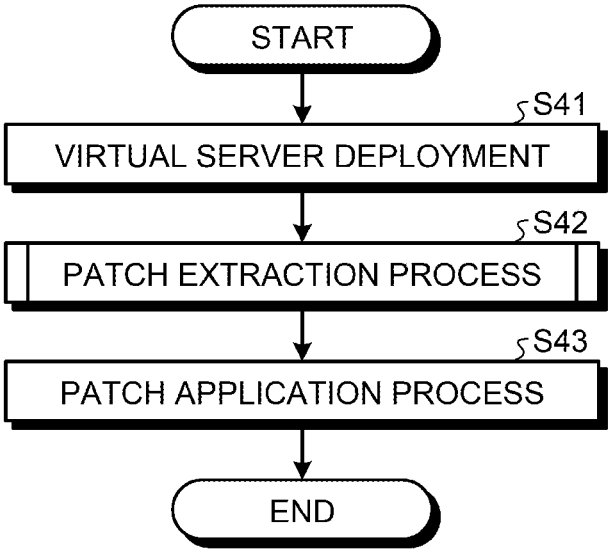

START
S41
VIRTUAL SERVER DEPLOYMENT
S42
PATCH EXTRACTION PROCESS
S43
PATCH APPLICATION PROCESS
END

FIG.13

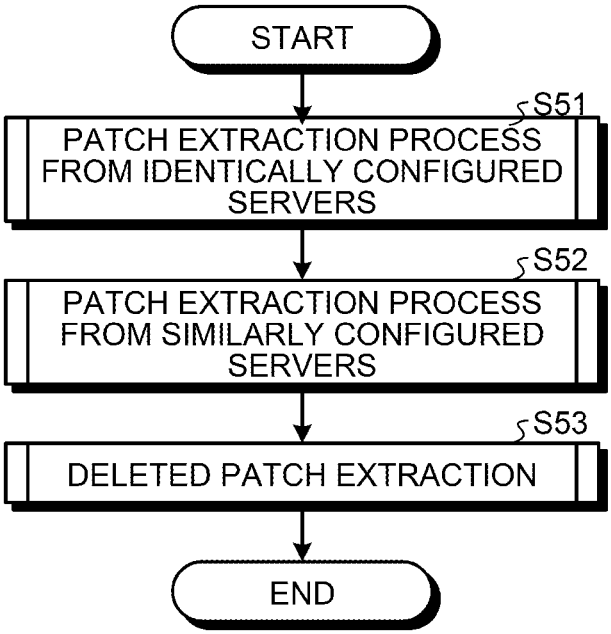

START
S51
PATCH EXTRACTION PROCESS FROM IDENTICALLY CONFIGURED SERVERS
S52
PATCH EXTRACTION PROCESS FROM SIMILARLY CONFIGURED SERVERS
S53
DELETED PATCH EXTRACTION
END

FIG.14

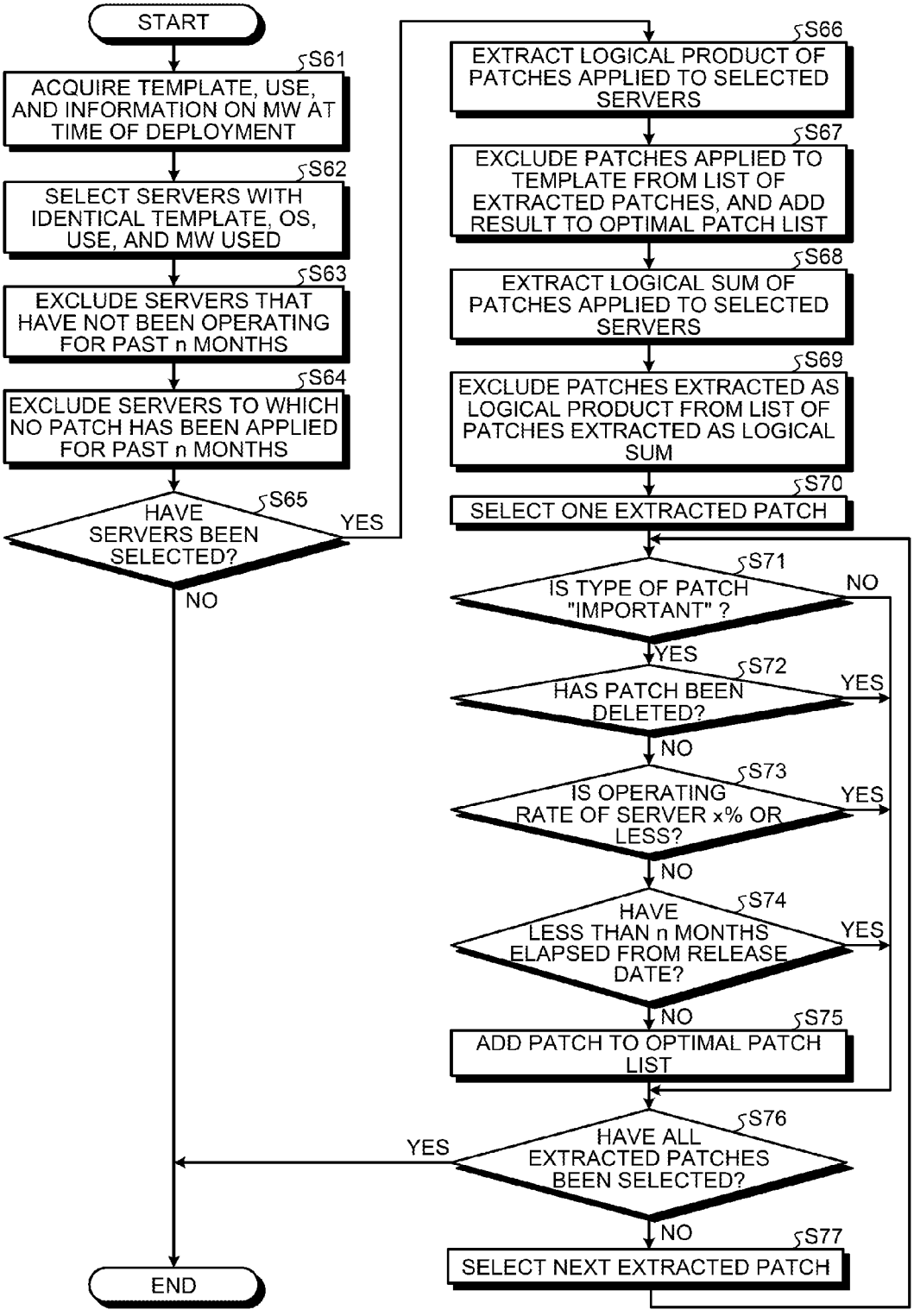

START
S61
ACQUIRE TEMPLATE, USE, AND INFORMATION ON MW AT TIME OF DEPLOYMENT
S62
SELECT SERVERS WITH IDENTICAL TEMPLATE, OS, USE, AND MW USED
S63
EXCLUDE SERVERS THAT HAVE NOT BEEN OPERATING FOR PAST n MONTHS
S64
EXCLUDE SERVERS TO WHICH NO PATCH HAS BEEN APPLIED FOR PAST n MONTHS
S65
HAVE SERVERS BEEN SELECTED?
YES
NO
END
S66
EXTRACT LOGICAL PRODUCT OF PATCHES APPLIED TO SELECTED SERVERS
S67
EXCLUDE PATCHES APPLIED TO TEMPLATE FROM LIST OF EXTRACTED PATCHES, AND ADD RESULT TO OPTIMAL PATCH LIST
S68
EXTRACT LOGICAL SUM OF PATCHES APPLIED TO SELECTED SERVERS
S69
EXCLUDE PATCHES EXTRACTED AS LOGICAL PRODUCT FROM LIST OF PATCHES EXTRACTED AS LOGICAL SUM
S70
SELECT ONE EXTRACTED PATCH
S71
IS TYPE OF PATCH "IMPORTANT" ?
NO
YES
S72
HAS PATCH BEEN DELETED?
YES
NO
S73
IS OPERATING RATE OF SERVER x% OR LESS?
YES
NO
S74
HAVE LESS THAN n MONTHS ELAPSED FROM RELEASE DATE?
YES
NO
S75
ADD PATCH TO OPTIMAL PATCH LIST
S76
HAVE ALL EXTRACTED PATCHES BEEN SELECTED?
YES
NO
S77
SELECT NEXT EXTRACTED PATCH

FIG.15

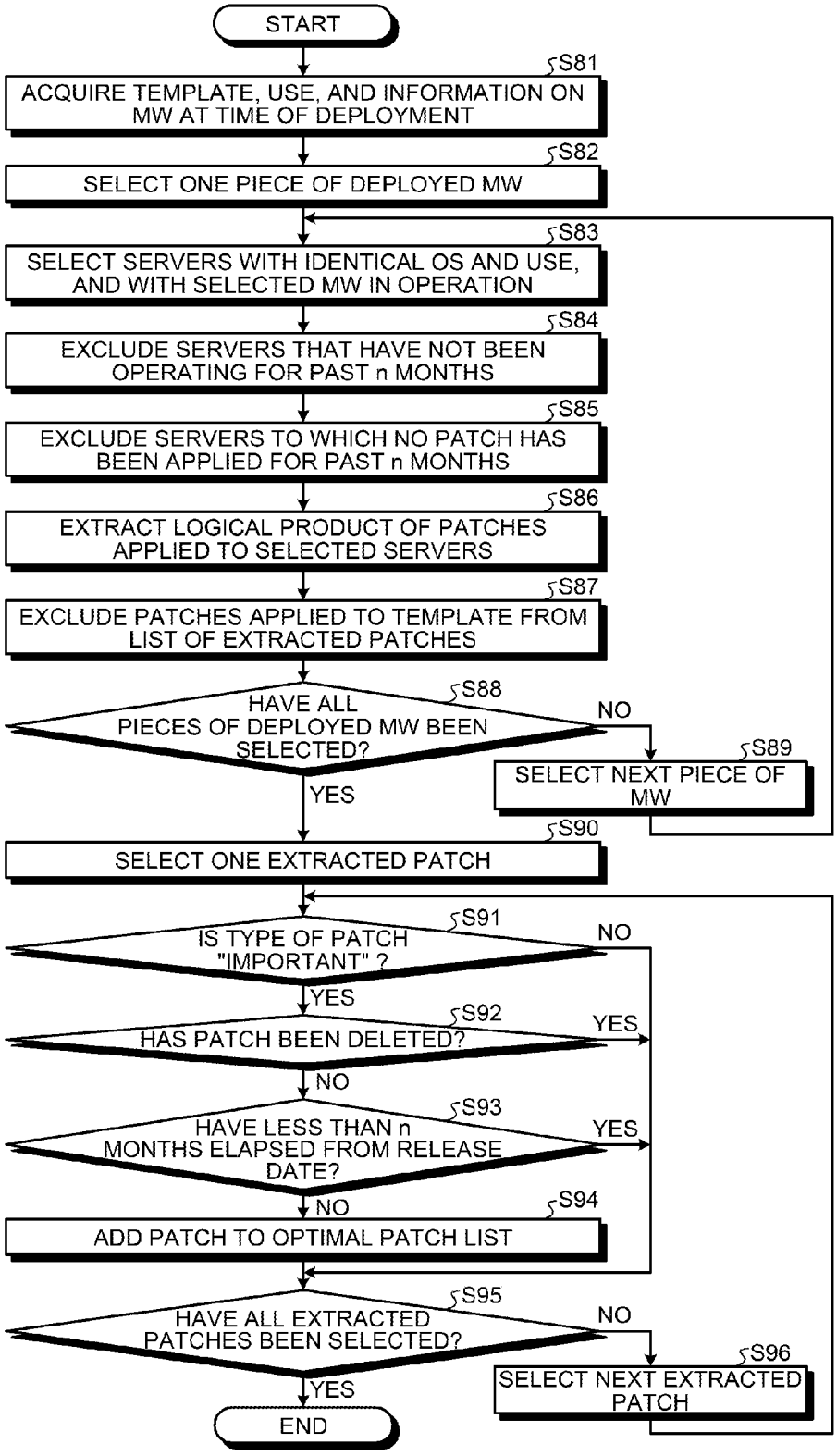

START
S81
ACQUIRE TEMPLATE, USE, AND INFORMATION ON MW AT TIME OF DEPLOYMENT
S82
SELECT ONE PIECE OF DEPLOYED MW
S83
SELECT SERVERS WITH IDENTICAL OS AND USE, AND WITH SELECTED MW IN OPERATION
S84
EXCLUDE SERVERS THAT HAVE NOT BEEN OPERATING FOR PAST n MONTHS
S85
EXCLUDE SERVERS TO WHICH NO PATCH HAS BEEN APPLIED FOR PAST n MONTHS
S86
EXTRACT LOGICAL PRODUCT OF PATCHES APPLIED TO SELECTED SERVERS
S87
EXCLUDE PATCHES APPLIED TO TEMPLATE FROM LIST OF EXTRACTED PATCHES
S88
HAVE ALL PIECES OF DEPLOYED MW BEEN SELECTED?
NO
S89
SELECT NEXT PIECE OF MW
YES
S90
SELECT ONE EXTRACTED PATCH
S91
IS TYPE OF PATCH "IMPORTANT" ?
NO
YES
S92
HAS PATCH BEEN DELETED?
YES
NO
S93
HAVE LESS THAN n MONTHS ELAPSED FROM RELEASE DATE?
YES
NO
S94
ADD PATCH TO OPTIMAL PATCH LIST
S95
HAVE ALL EXTRACTED PATCHES BEEN SELECTED?
NO
S96
SELECT NEXT EXTRACTED PATCH
YES
END

FIG.16

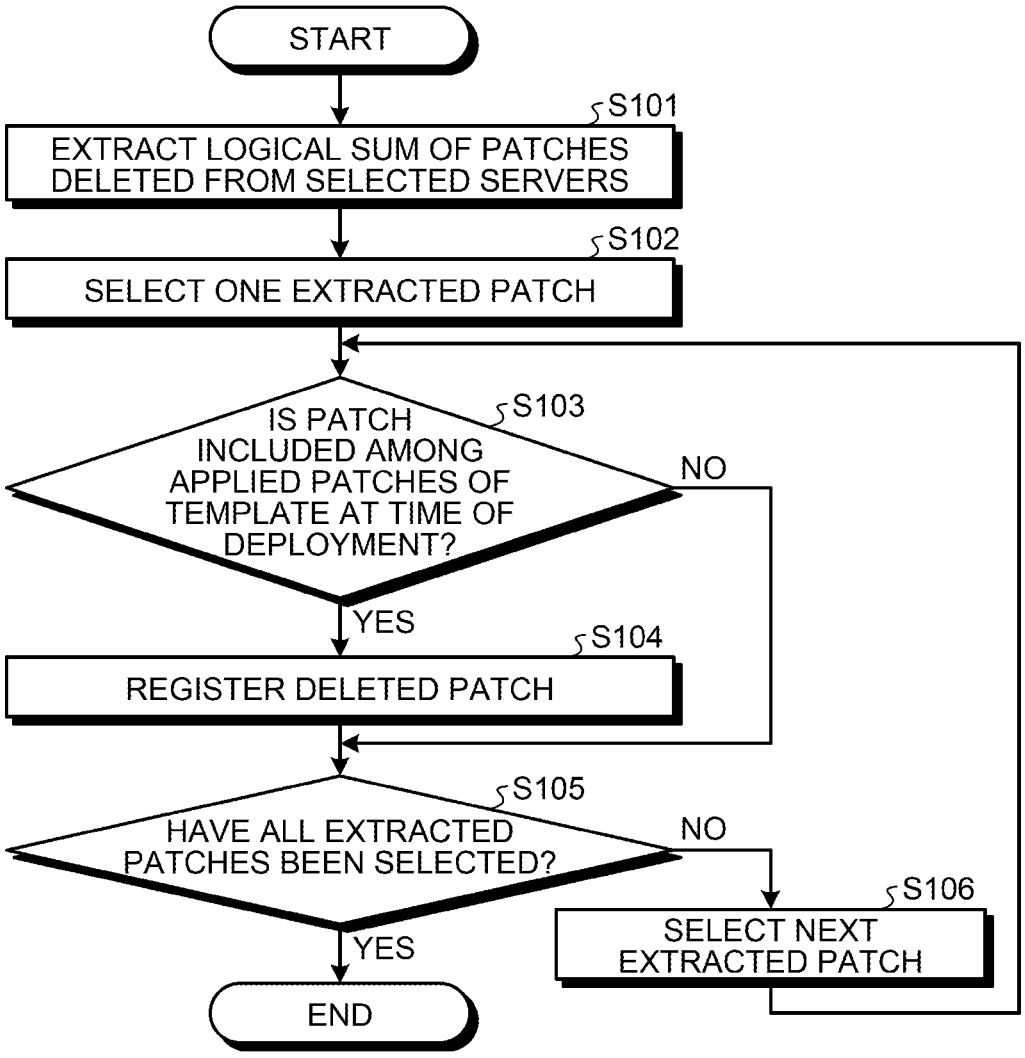
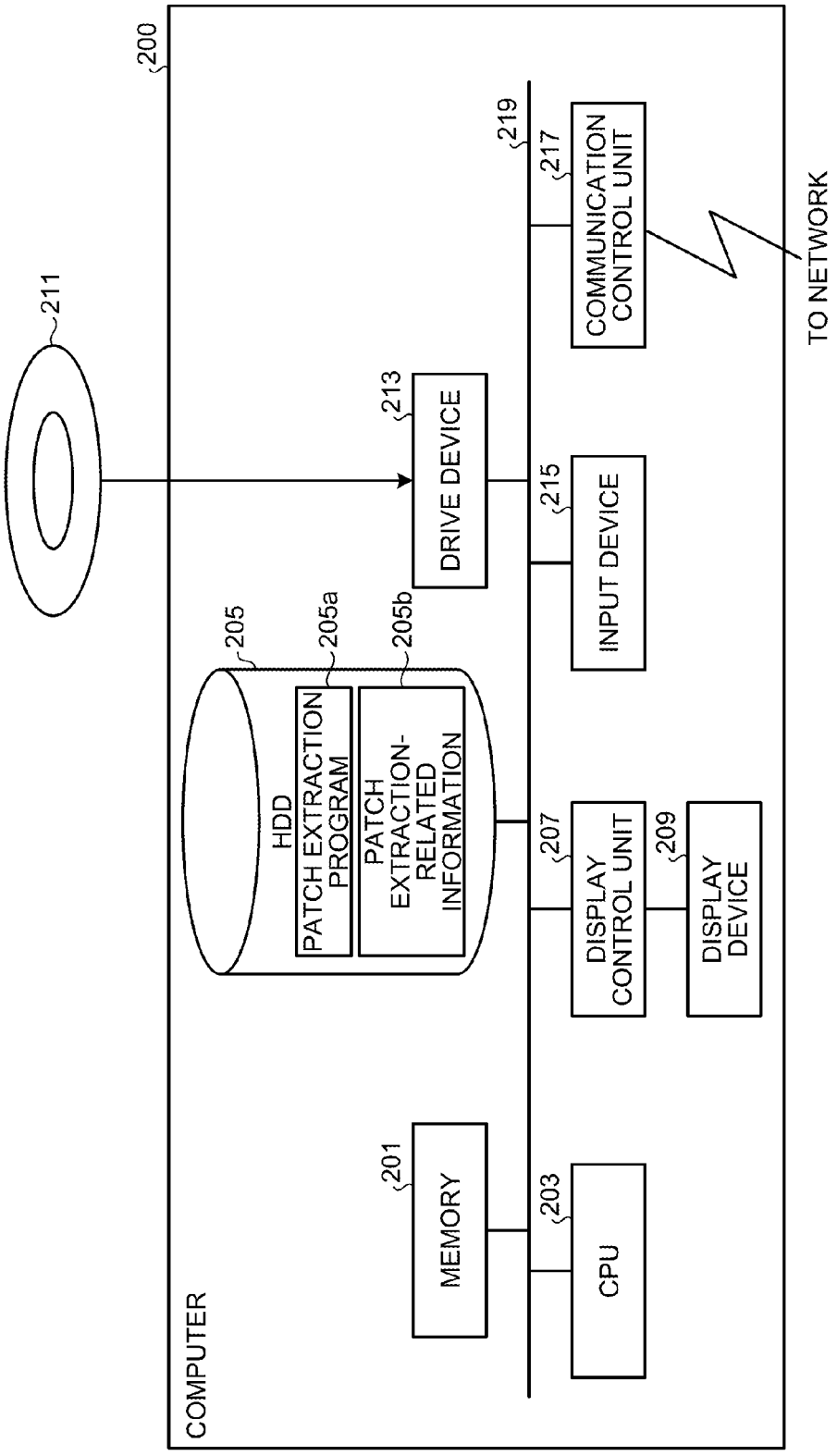

START
S101
EXTRACT LOGICAL SUM OF PATCHES DELETED FROM SELECTED SERVERS
S102
SELECT ONE EXTRACTED PATCH
S103
IS PATCH INCLUDED AMONG APPLIED PATCHES OF TEMPLATE AT TIME OF DEPLOYMENT?
NO
YES
S104
REGISTER DELETED PATCH
S105
HAVE ALL EXTRACTED PATCHES BEEN SELECTED?
NO
YES
S106
SELECT NEXT EXTRACTED PATCH
END

FIG.17


200
COMPUTER
211
213
DRIVE DEVICE
205
205a
205b
HDD
PATCH EXTRACTION PROGRAM
PATCH EXTRACTION-RELATED INFORMATION
219
217
COMMUNICATION CONTROL UNIT
TO NETWORK
215
INPUT DEVICE
207
DISPLAY CONTROL UNIT
209
DISPLAY DEVICE
201
MEMORY
203
CPU

METHOD AND INFORMATION PROCESSING APPARATUS FOR EXTRACTING SOFTWARE CORRECTION PATCH FOR VIRTUAL MACHINE

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2013-132123, filed on Jun. 24, 2013, the entire contents of which are incorporated herein by reference.

FIELD

The embodiment discussed herein is directed to a software correction patch extraction program.

BACKGROUND

When a virtual machine is generated on a physical machine, a software correction patch (patch) is applied to the virtual machine, and then the virtual machine is used for operations. The patch partially corrects software.

For example, a user selects a patch to be applied. Specifically, the user selects a patch that has not been applied to the generated virtual machine from patches provided by a vendor of the software that runs on the virtual machine.

A technology exists that updates a non-running out-of-date virtual machine. According to such a technology, the virtual machine includes a plurality of software structures. The non-running out-of-date virtual machine is retrieved from a library, and is restarted on a maintenance host. The maintenance host acquires a needed software update as a patch from a corresponding update source so as to update each of the out-of-date software structures (refer to Japanese National Publication of International Patent Application No. 2009-538469, for example).

However, conventional technologies of selecting a patch have a problem of not being capable of selecting an optimal patch.

As an example, a user who is not familiar with a machine environment, including an OS and middleware, is not capable of selecting an optimal patch to be applied to the virtual machine.

As another example, the technologies for updating the non-running out-of-date virtual machine merely acquire a patch of out-of-date software and update the software, and thus, the update by the patch can cause trouble in later operations. In other words, the technologies for updating the non-running out-of-date virtual machine is not always capable of selecting an optimal patch.

SUMMARY

According to an aspect of an embodiment, a non-transitory computer-readable recording medium stores a software correction patch extraction program that causes a computer to execute a process. The process includes referring to a storage unit that stores therein information on a plurality of virtual machines generated from a plurality of virtual images and information on software that operates on each of the plurality of virtual machines. The process includes selecting other virtual machine in conjunction with a particular virtual machine from the plurality of virtual machines based on information on the particular virtual machine generated from a certain virtual image and information on software that operates on the particular virtual machine. The process includes extracting a software correction patch to be applied to the particular virtual machine based on the software correction patches applied to the other virtual machine selected at the selecting.

The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram illustrating an overall configuration of a management system including a management server according to an embodiment of the present invention;

FIG. **2** is a diagram illustrating an example of a data structure of a patch management DB;

FIG. **3** is a diagram illustrating an example of a media library;

FIG. **4** is a diagram illustrating an example of a data structure of a template management DB;

FIG. **5** is a diagram illustrating an example of a data structure of a server information management DB;

FIG. **6** is a diagram illustrating an example of a data structure of server list data;

FIG. **7** is a diagram illustrating an example of a data structure of optimal patch list data;

FIG. **8** is a diagram illustrating a specific example of a patch extraction process according to the embodiment;

FIG. **9** is a flowchart illustrating an overall procedure of a server information collection process according to the embodiment;

FIG. **10** is a flowchart illustrating a procedure of the server information collection process according to the embodiment;

FIG. **11** is a flowchart illustrating a procedure of a middleware operational status acquisition process;

FIG. **12** is a flowchart illustrating an overall procedure of a virtual server deployment process according to the embodiment;

FIG. **13** is a flowchart illustrating a procedure of the patch extraction process;

FIG. **14** is a flowchart illustrating a procedure of the patch extraction process from identically configured servers;

FIG. **15** is a flowchart illustrating a procedure of the patch extraction process from similarly configured servers;

FIG. **16** is a flowchart illustrating a procedure of a deleted patch extraction process; and

FIG. **17** is a diagram illustrating an example of a computer that executes a patch extraction program.

DESCRIPTION OF EMBODIMENT

Preferred embodiments of the present invention will be explained with reference to accompanying drawings. The embodiment does not limit the present invention.

Configuration of Management System According to Embodiment

FIG. **1** is a diagram illustrating an overall configuration of a management system including a management server according to the embodiment. As illustrated in FIG. **1**, this management system **9** includes a management server **1** and a plurality of virtual servers **2**. The management server **1** and the virtual servers **2** are connected together via a network **3**. Each of the virtual servers **2** is a virtual machine (VM), and is

installed on a physical machine. The virtual servers **2** may be installed on one physical machine, or may be installed one on each physical machine.

Each of the virtual server **2** is deployed from a virtual image (template). The term "virtual image" here refers to an image of an operating system (OS) and middleware (MW) that is deployed to the virtual server **2** and installed on an actual machine. Patches to be applied to the virtual servers **2** are applied to the virtual images. Applications to be deployed to the virtual servers **2** may be installed in the virtual images.

Each of the virtual servers **2** includes an OS **21**, MW **22**, patches **23**, and an agent **24**. The OS **21**, the MW **22**, the patches **23**, and the agent **24** are deployed from each of the virtual images before each of the virtual servers **2** is operated. The deployed virtual images are selected, for example, by a user. After the virtual server **2** has started operating, any of the patches **23** are newly applied or deleted. The patches **23** include a patch of the OS **21** and a patch or patches of the MW **22**. The agent (to be described later) performs new application and deletion of the patches **23**. The agents **24** are preinstalled in all the virtual images.

The agent **24** collects, for example, an operational status, information on the installed MW, and patch application information of the virtual server **2** under the control thereof, as appropriate, and performs new application and deletion of the patches **23**. The agent **24** sends the collected information to the management server **1**.

As an example, when instructed by the management server **1**, the agent **24** collects various types of information on the virtual server **2** under the control thereof. The term "various types of information" here refers to, for example, operational information, log information on services or processes that start the MW, and an application status of the patches of the virtual server **2**. The operational information of the virtual server **2** includes an operating rate of the virtual server **2**. The log information on the services or processes that start the MW includes the size of the log of services or processes that start the MW. The various types of information include the log information on the services or processes that start the MW in order to allow a server information collection unit **121** (to be described later) to determine the operational status of the MW. Specifically, daily changes in the size of the log included in the log information allow the server information collection unit **121** to determine that the MW corresponding to the log is operating.

As another example, the agent **24** collects various types of information on the virtual server **2** when the virtual image is deployed to the virtual server **2** under the control thereof. In this case, the various types of information include, for example, an identification name, the OS, and the use of the virtual server **2**, an installation status and an installation destination of the MW, information on the services or processes that start the MW, and the application status of the patches. Specifically, the agent **24** collects the installation status and the installation destination of the MW from an area that differs depending on the OS. For example, the agent **24** acquires them from the registry when the OS is Windows (registered trademark), or collects them from package information when the OS is UNIX (registered trademark). The agent **24** collects the information on the services or processes that start the MW from an area that differs depending on the OS. For example, the information on the services that start the MW is collected from the registry when the OS is Windows. The information on the processes that start the MW is collected from a destination module of the installation when the OS is UNIX.

As another example, the agent **24** collects various types of information on the virtual server **2** when new MW is added to the virtual server **2** under the control thereof. In this case, the various types of information include, for example, an installation status and an installation destination of the new MW, and the information on the services or processes that start the MW.

The management server **1** collects the operational information, the information on the MW, and the patch application information of existing virtual servers **2**, and selects virtual servers **2** that have an identical configuration or similar configurations. Then, the management server **1** extracts patches to be applied to a virtual server **2** to be deployed from patches applied to the selected virtual servers **2**. The management server **1** includes a storage unit **11** and a control unit **12**.

The storage unit **11** corresponds to a storage device including, for example, a nonvolatile semiconductor memory device, such as a flash memory and a Ferroelectric Random Access Memory (FRAM, registered trademark). The storage unit **11** includes a patch management database (DB) **111**, a media library **112**, a template management DB **113**, a server information management DB **114**, server list data **115**, and optimal patch list data **116**.

The patch management DB **111** manages information on patches released by vendors of the OSs and the MW in association with products and versions thereof. A data structure of the patch management DB **111** will be described with reference to FIG. **2**. FIG. **2** is a diagram illustrating an example of the data structure of the patch management DB. As illustrated in FIG. **2**, the patch management DB **111** stores therein a patch **111***a*, a product **111***b*, a type **111***c*, a summary **111***d*, a release date **111***e*, and a patch storage location **111***f*, in a mutually corresponding manner. The patch **111***a* represents an identification name of a patch. The product **111***b* represents an identification name of a product composed of a name and a version of the product to which the patch is to be applied. The type **111***c* represents a type of the patch. For example, the type **111***c* indicates whether the patch is a patch for security reasons, or whether the patch is important. The summary **111***d* represents a summary of the patch. The release date **111***e* represents the latest release date of the patch. The patch storage location **111***f* represents a storage location of the patch.

As an example, when the patch **111***a* is set to "Patch A", the patch management DB **111** stores therein "XXXX2008" as the product **111***b*, "Security" as the type **111***c*, "20XX/06/01" as the release date **111***e*, and "/Patch/OS/XXXX/ . . . " as the patch storage location **111***f*.

Referring back to FIG. **1**, the media library **112** manages the patches themselves and scripts used for applying the patches as respective sets. An example of the media library **112** will be described with reference to FIG. **3**. FIG. **3** is a diagram illustrating the example of the media library. As illustrated in FIG. **3**, the media library **112** stores therein correction files and application scripts in a mutually corresponding manner on a patch-by-patch basis. Each of the correction files represents a storage location where the patch itself exists. Each of the application scripts represents a storage location where the script used for applying the patch exists. As an example, the correction file and the application script of Patch A are stored under "/Patch/OS/XXXX/Patch A". In other words, the storage location of the correction file and the application script for each patch corresponds to the patch storage location **111***f* of the patch management DB **111**.

Referring back to FIG. **1**, the template management DB **113** manages the templates of the virtual images. Specifically, the template management DB **113** manages information on

the OSs and the MW installed in the virtual images, and the patches already applied to the virtual images. A data structure of the template management DB **113** will be described with reference to FIG. **4**. FIG. **4** is a diagram illustrating an example of the data structure of the template management DB. As illustrated in FIG. **4**, the template management DB **113** stores therein a template **113***a*, an OS **113***b*, MW information **113***c*, and an applied patch **113***g*, in a mutually corresponding manner. The MW information **113***c* includes an installed MW **113***d*, an installation destination **113***e*, and a service/process **113***f*.

The template **113***a* represents an identification name of a template corresponding to a virtual image. The OS **113***b* represents an OS constituting the template. The MW information **113***c* represents the information on MW constituting the template. The installed MW **113***d* represents MW installed in the virtual image corresponding to the template. The installation destination **113***e* represents a location where the installed MW **113***d* is installed in the virtual image corresponding to the template. The service/process **113***f* represents the information on services or processes that start the installed MW **113***d*. The applied patch **113***g* represents patches already applied to the virtual image corresponding to the template.

As an example, when the template **113***a* is set to "Template 1", the template management DB **113** stores therein "XXXX2008" as the OS **113***b*, "ABC V2" as the installed MW **113***d*, "C:\ABC" as the installation destination **113***e*, "ABC service" as the service/process **113***f*, and "Patch A Patch C" as the applied patch **113***g*.

Referring back to FIG. **1**, the server information management DB **114** manages the OSs, selected templates, the uses, operation records, the information on the MW, and the information on the patches of the virtual servers **2**, on a server-by-server basis. The server list data **115** is a list of virtual servers that are temporarily used when the patches are extracted by a patch extraction unit **123** (to be described later). The optimal patch list data **116** is a list of optimal patches extracted by the patch extraction unit **123** (to be described later). The server information management DB **114**, the server list data **115**, and the optimal patch list data **116** will be described in detail later.

The control unit **12** has an internal memory for storing therein programs specifying various processing procedures and control data, and uses the programs and the control data to perform various processes. The control unit **12** corresponds to an electronic circuit in the form of an integrated circuit such as an application-specific integrated circuit (ASIC) or a field-programmable gate array (FPGA). The control unit **12** also corresponds to an electronic circuit such as a central processing unit (CPU) or a microprocessing unit (MPU). Furthermore, the control unit **12** includes the server information collection unit **121**, a virtual server deployment unit **122**, the patch extraction unit **123**, and a patch application unit **124**.

The server information collection unit **121** collects various types of information on the virtual servers **2**, on a server-by-server basis. As an example, the server information collection unit **121** periodically (for example, once a day) collects the various types of information on all of the virtual servers **2** managed by the server information management DB **114** via the agents **24**. The term "various types of information" here refers to, for example, the operational information, the log information on the services or processes that start the MW, and the application status of the patches of the virtual servers **2**.

The server information collection unit **121** determines the operational status of each of the virtual servers **2**, based on whether information can be collected from the virtual server **2**. Specifically, the server information collection unit **121** determines that the virtual server **2** is in operation when having succeeded in collecting information from the virtual server **2**. The server information collection unit **121** determines that the virtual server **2** is not in operation when having failed in collecting information from the virtual server **2**. The server information collection unit **121** stores the determination result in the server information management DB **114**.

The server information collection unit **121** determines the operational status of the MW corresponding to the virtual server **2**. For example, the server information collection unit **121** compares the size of the currently collected log of the services or processes that start the MW corresponding to the virtual server **2** with the size of the previously collected log of the services or processes that start the same MW, and determines the operational status of the MW. If the size of the currently collected log about the MW differs from the size of the previously collected log about the MW, the server information collection unit **121** determines that the MW is in operation. If the size of the currently collected log about the MW is the same as the size of the previously collected log about the MW, the server information collection unit **121** determines that the MW is not in operation. The server information collection unit **121** stores the determination result in the server information management DB **114**.

The server information collection unit **121** compares the MW information on the virtual image corresponding to the virtual server **2** with the currently collected MW information, and determines MW that has been added or deleted after the deployment. As an example, when the currently collected MW information on the MW is not found in the MW information of the virtual image, the server information collection unit **121** determines that the MW has been added. When the MW information of the virtual image is not found in the currently collected MW information on the MW, the server information collection unit **121** determines that the MW has been deleted.

The server information collection unit **121** compares the information on the patches applied to the virtual image corresponding to the virtual server **2** with the currently collected information on patches, and determines patches that have been added or deleted after the deployment. In addition, the server information collection unit **121** compares the previously collected information on patches with the currently collected information on the patches, and determines patches that have been added or deleted after the previous collection.

A data structure of the server information management DB **114** will be described with reference to FIG. **5**. FIG. **5** is a diagram illustrating an example of the data structure of the server information management DB. As illustrated in FIG. **5**, the server information management DB **114** stores therein an OS **114***b*, a template **114***c*, a use **114***d*, an operation record (last check date) **114***e*, an operating rate **114***f*, and MW information **114***g*, in association with a server **114***a*. The server information management DB **114** also stores therein a last patch application date **1141**, an applied patch **114***m*, and a deleted patch **114***n*, in association with the server **114***a*. The MW information **114***g* includes installed MW **114***h*, an operational status **114***i*, an installation destination **114***j*, and a service/process (log size) **114***k*.

The server **114***a* represents an identification name of a virtual server. The OS **114***b* represents an OS deployed to the server **114***a*. The template **114***c* represents a template used when the server **114***a* is deployed. The server **114***a*, the OS **114***b*, and the template **114***c* are collected and stored, for

example, in advance when the virtual image is deployed to the virtual server **2** represented by the server **114***a*.

The use **114***d* represents the use of the server **114***a*. For example, the use **114***d* is stored to be "Web" when the server **114***a* is used as a web server, "Application (AP)" when the server **114***a* is used as an application server, or "Database (DB)" when the server **114***a* is used as a database server. The storage is performed, for example, when the virtual image is deployed to the virtual server **2** represented by the server **114***a*. If the use of the virtual server **2** represented by the server **114***a* is "AP" at the time of deployment, the use **114***d* is updated to "AP+DB" when software of a DB is installed later.

The operation record (last check date) **114***e* represents the operational status of the virtual server **2** represented by the server **114***a*. For example, the operation record (last check date) **114***e* is stored to be "O" indicating that the virtual server **2** is in operation, or "X" indicating that the virtual server **2** is not in operation. In addition, a last check date of the operational status is stored. The operating rate **114***f* represents the operating rate of the virtual server **2** represented by the server **114***a*. The server information collection unit **121** collects and stores the operation record (last check date) **114***e* and the operating rate **114***f*.

The installed MW **114***h* represents the MW already installed in the virtual server **2** represented by the server **114***a*. The operational status **114***i* represents the operational status of the MW represented by the installed MW **114***h*. For example, the operational status **114***i* is stored to be "O" indicating that the MW is in operation, or "X" indicating that the MW is not in operation. The installation destination **114***j* represents the location where the MW represented by the installed MW **114***h* is installed on the server **114***a*. The service/process (log size) **114***k* represents the services or processes that start the MW represented by the installed MW **114***h*. The service/process (log size) **114***k* is set to names of the services or processes that start the MW, and sizes of the collected logs of the services or processes. The server information collection unit **121** stores the operational status **114***i*. The installed MW **114***h* and the installation destination **114***j* are stored when the virtual image is deployed or the MW is added to the virtual server **2** represented by the server **114***a*. The service/process (log size) **114***k* is stored when the server information collection unit **121** has collected the logs of the services or processes when the virtual image was deployed or the MW was added to the virtual server **2** represented by the server **114***a*.

The last patch application date **1141** represents a date when the applied patch **114***m* (to be described later) was last applied. The applied patch **114***m* represents patches already applied to the virtual server **2** represented by the server **114***a*. The deleted patch **114***n* represents patches deleted from the virtual server **2** represented by the server **114***a*. The server information collection unit **121** collects and stores the last patch application date **1141** and the applied patch **114***m*. The deleted patches determined by the server information collection unit **121** are stored as the deleted patch **114***n*.

Referring back to FIG. **1**, the virtual server deployment unit **122** performs the deployment to the virtual server **2** using the virtual image selected by the user. Thus, the virtual server deployment unit **122** deploys the OS and the MW installed as the virtual image and the patches applied as the virtual image to the virtual server **2**.

With reference to the server information management DB **114**, the patch extraction unit **123** selects other virtual servers **2**, based on the information on the virtual server **2** deployed by the virtual server deployment unit **122** and the information on the MW. For example, the patch extraction unit **123** acquires the identification name of the template, the OS, the use, and the MW information of the virtual server **2** deployed by the virtual server deployment unit **122**. Then, with reference to the server information management DB **114**, the patch extraction unit **123** selects other virtual servers **2** that are the same as the deployed virtual server **2** in terms of the identification name of the template, the OS, the use, and a configuration of the MW. At this time, with reference to the server information management DB **114**, the patch extraction unit **123** excludes other virtual servers **2** that have neither been operating nor been patched for a certain past period. This is because the virtual servers **2** that have neither been operating nor been patched for a certain past period may have had no maintenance, and a needed patch may not be extracted. The certain past period is, for example, six months, but only needs to be a period enough to determine that no maintenance has been carried out. Then, the patch extraction unit **123** lists all of the selected other virtual servers **2** in the server list data **115**.

A data structure of the server list data **115** will be described with reference to FIG. **6**. FIG. **6** is a diagram illustrating an example of the data structure of the server list data. As illustrated in FIG. **6**, the server list data **115** stores therein an OS **115***b*, a template **115***c*, a use **115***d*, and an installed MW **115***e*, in association with a server **115***a*. The server **115***a*, the OS **115***b*, the template **115***c*, the use **115***d*, and the installed MW **115***e* correspond to the server **114***a*, the OS **114***b*, the template **114***c*, the use **114***d*, and the installed MW **114***h*, respectively, of the server information management DB **114**. That is, the patch extraction unit **123** copies the information on all of the selected other virtual servers **2** stored in the server information management DB **114** to the server list data **115**.

As an example, when the server **115***a* is set to "Server 4", the server list data **115** stores therein "XXXX2008" as the OS **115***b*, "Template 1" as the template **115***c*, "AP" as the use **115***d*, and "ABC V2 XYZ V10" as the installed MW **115***e*.

Referring back to FIG. **1**, when more than one of the other virtual servers **2** has been selected, the patch extraction unit **123** extracts, as patches to be applied, patches applied in common to the other virtual servers **2** among respective patches applied thereto. Also, the patch extraction unit **123** selects patches applied to any of the other virtual servers **2**. The patch extraction unit **123** extracts, among the selected patches, patches that are set to "Important" as the patch type, that have not been deleted on the other virtual servers **2**, that are on the virtual servers **2** having operated at more than a predetermined operating rate, and that are up to date but not just released, as patches to be applied. The patch management DB **111** is used to determine whether the patch type is "Important" and whether the patches are up to date but not just released. The server information management DB **114** is used to determine whether the patches have not been deleted on the other virtual servers **2** and whether the patches are on the virtual servers **2** that have operated at more than a predetermined operating rate. The reason for extracting the patches that have not been deleted on the other virtual servers **2** is that the patches are presumed to have no influence on the operation of jobs. The reason for extracting the patches that are on the virtual servers **2** that have operated at more than a predetermined operating rate is that applying the patches are presumed to have no influence. The reason for extracting the patches that are up to date but not just released is that the patches are presumed to have proven records. The patch extraction unit **123** stores the extracted patches to be applied in the optimal patch list data **116**.

When the patch extraction unit **123** has not succeeded in selecting the other virtual servers **2** that are the same as the

deployed virtual server **2** in terms of the identification name of the template, the OS, the use, and the configuration of the MW, the patch extraction unit **123** selects other virtual servers **2** that have similar configurations to that of the deployed virtual server **2**. For example, with reference to the server information management DB **114**, the patch extraction unit **123** selects other virtual servers **2** that are the same as the deployed virtual server **2** in terms of the OS, the use, and any piece of the MW. At this time, with reference to the server information management DB **114**, the patch extraction unit **123** excludes other virtual servers **2** that have neither been operating nor been patched for a certain past period. This is because the virtual servers **2** that have neither been operating nor been patched for a certain past period may have had no maintenance, and a needed patch may not be able to be extracted. The certain past period is, for example, six months, but only needs to be a period enough to determine that no maintenance has been carried out. Then, the patch extraction unit **123** lists all of the selected other virtual servers **2** in the server list data **115**.

When more than one of the other virtual servers **2** has been selected, the patch extraction unit **123** selects patches applied in common to the other virtual servers **2** among respective patches applied thereto. The patch extraction unit **123** extracts, among the selected patches, patches that are set to "Important" as the patch type, that have not been deleted on the other virtual servers **2**, and that are up to date but not just released, as patches to be applied. The patch management DB **111** is used to determine whether the patch type is "Important" and whether the patches are up to date but not just released. The server information management DB **114** is used to determine whether the patches have not been deleted on the other virtual servers **2**. The patch extraction unit **123** stores the extracted patches to be applied in the optimal patch list data **116**.

The patch extraction unit **123** deletes unneeded patches from the patches deployed by the virtual server deployment unit **122**. Specifically, if any of the patches applied in advance to the virtual image of the template have been deleted while the other virtual servers **2** are operating, the patch extraction unit **123** determines the deleted patches as application-canceled patches. For example, with reference to the server information management DB **114**, the patch extraction unit **123** selects the already deleted patches from the selected other virtual servers **2**. Then, with reference to the template management DB **113**, the patch extraction unit **123** determines whether the selected already deleted patches have been applied to the template of the deployed virtual server **2**. The patch extraction unit **123** registers the applied patches as the application-canceled patches in the optimal patch list data **116**.

A data structure of the optimal patch list data **116** will be described with reference to FIG. **7**. FIG. **7** is a diagram illustrating an example of the data structure of the optimal patch list data. As illustrated in FIG. **7**, the optimal patch list data **116** stores therein an OS **116***b*, a use **116***c*, MW **116***d*, an applied patch **116***e*, an optimal patch **116***f*, and an application-canceled patch **116***g*, in association with a template **116***a*. The template **116***a*, the OS **116***b*, the MW **116***d*, and the applied patch **116***e* correspond to the template **113***a*, the OS **113***b*, the installed MW **113***d*, and the applied patch **113***g*, respectively, of the template management DB **113**. The use **116***c* corresponds to the use **114***d* of the server information management DB **114**. The optimal patch **116***f* represents patches other than the already applied patches among the patches to be applied that have been extracted by the patch extraction unit **123**. The application-canceled patch **116***g* represents the application-canceled patches extracted by the patch extraction unit **123**. The template **113***a*, the OS **113***b*, the installed MW **113***d*, and the applied patch **113***g* stored in the template management DB **113** corresponding to those of the deployed virtual server **2** are stored as the template **116***a*, the OS **116***b*, the MW **116***d*, and the applied patch **116***e*, respectively. The use **114***d* stored in the server information management DB **114** corresponding to that of the deployed virtual server **2** is stored as the use **116***c*.

As an example, when the template **116***a* is set to "Template 1", the optimal patch list data **116** stores therein "XXXX2008" as the OS **116***b*, "AP" as the use **116***c*, "XYZ V10" as the MW **116***d*, "Patch A Patch C" as the applied patch **116***e*, "Patch B Patch E Patch G" as the optimal patch **116***f*, and "Patch C" as the application-canceled patch **116***g*.

Referring back to FIG. **1**, the patch application unit **124** applies the optimal patches to the deployed virtual server **2**. The patch application unit **124** deletes the patches excluded from application among the patches applied to the deployed virtual server **2**. For example, with reference to the optimal patch list data **116**, the patch application unit **124** applies the optimal patch **116***f* to the virtual server **2** deployed by the virtual server deployment unit **122**, via the agent **24**. Also, with reference to the optimal patch list data **116**, the patch application unit **124** deletes the application-canceled patch **116***g* from the virtual server **2** deployed by the virtual server deployment unit **122**, via the agent **24**.

Specific Example of Patch Extraction Process

FIG. **8** is a diagram illustrating a specific example of a patch extraction process according to the embodiment. In FIG. **8**, a virtual image of a template 1 is deployed to a virtual server (**4**). As illustrated in FIG. **8**, an OS, and MW a and b are installed, and patches A, B, and C are applied, to the virtual image of the template 1. The template management DB **113** manages the template 1 of the virtual image.

Under this situation, the server information collection unit **121** periodically collects various types of information from all of the virtual servers **2** managed by the server information management DB **114**. In this case, the server information collection unit **121** collects log sizes of services or processes as the MW information, and the application status of the patches from the virtual servers (**1**) and (**2**)

The server information collection unit **121** stores the collected various types of information in the server information management DB **114**. In this case, with respect to the virtual server (**1**), a log size **114***k***0** of a service that starts the MW a is stored to be **100** as the MW information corresponding to the MW a. The log size **114***k***0** of a service that starts the MW b is stored to be **120** as the MW information corresponding to the MW b. The log size **114***k***0** of a service that starts MW c is stored to be **110** as the MW information corresponding to the MW c. "A B D E" is stored as the applied patch **114***m*. With respect to the virtual server (**2**), the log size **114***k***0** of a service that starts the MW a is stored to be **100** as the MW information corresponding to the MW a. "A B C E" is stored as the applied patch **114***m*.

The server information collection unit **121** compares the size of the currently collected log of the service that starts each piece of the MW corresponding to each of the virtual servers **2** with the size of the previously collected log of the service that starts the same MW, and determines whether the MW is in operation. The server information collection unit **121** stores the determination result for each piece of the MW on each of the virtual servers **2** in the server information management DB **114**. In this case, the size is the same between the previous log and the current log for the MW a corresponding to the virtual server (**1**), so that the MW a is

determined as not being in operation, and thus, "X" is stored. The size differs between the previous log and the current log for the MW b corresponding to the virtual server (**1**), so that the MW b is determined as being in operation, and thus, "O" is stored. In the same manner, the MW c corresponding to the virtual server (**1**) is determined as being in operation, and thus, "O" is stored. The MW a corresponding to the virtual server (**2**) is determined as being in operation, and thus, "O" is stored.

Then, the server information collection unit **121** compares the configuration of the MW of the virtual image corresponding to each of the virtual servers **2** with the currently collected configuration of the MW, and determines MW that has been added or deleted after the deployment. In this case, the "Template 1" was used when the virtual server (**1**) was deployed. Accordingly, the server information collection unit **121** compares the configuration of the M (MW a and MW b) corresponding to the template 1 of the template management DB **113** with the current configuration of the M (MW a, MW b, and MW c) corresponding to the virtual server (**1**) of the server information management DB **114**. The server information collection unit **121** determines that the MW c has been added after the deployment. In the same manner, the server information collection unit **121** determines that the MW b has been deleted from the virtual server (**2**) after the deployment.

As an example, the server information collection unit **121** compares the information on the patches applied to the virtual image corresponding to each of the virtual servers **2** with the currently collected information on patches, and determines patches that have been added or deleted after the deployment. The server information collection unit **121** stores the determination result for each of the virtual servers **2** in the server information management DB **114**. In this case, for the virtual server (**1**), the previously collected information on the patches is represented as "A B C D E", and the currently collected information on the patches is represented as "A B D E". This causes the server information collection unit **121** to determine that the patch C has been deleted, and store "C" as the deleted patch **114***n*.

The virtual server deployment unit **122** performs the deployment to the virtual server (**4**) using the virtual image. In this case, the OS, and the MW a and b are deployed, and the patches A, B, and C are applied.

The patch extraction unit **123** acquires the identification name of the template, the OS, the use, and the configuration of the MW of the deployed virtual server (**4**), with reference to the template management DB **113**. With reference to the server information management DB **114**, the patch extraction unit **123** selects other virtual servers **2** that are the same as the deployed virtual server (**4**) in terms of the identification name of the template, the OS, the use, and the configuration of the MW. In this case, the configuration of the MW of the deployed virtual server (**4**) is represented as "MW a MW b". However, the configuration of the MW of the deployed virtual server (**1**) is represented as "MW a MW b MW c", and the configuration of the MW of the deployed virtual server (**2**) is represented as "MW a". This does not allow the patch extraction unit **123** to select other virtual servers **2** that are the same as the deployed virtual server (**4**) in terms of the identification name of the template, the OS, the use, and the configuration of the MW.

This leads the patch extraction unit **123** to select other virtual servers **2** that have similar configurations to that of the deployed virtual server (**4**). For example, with reference to the server information management DB **114**, the patch extraction unit **123** selects other virtual servers **2** that are the same as the deployed virtual server (**4**) in terms of the OS, the use, and any piece of the MW. In this case, the virtual servers (**1**) and (**2**) are selected.

Since more than one of the other virtual servers **2** has been selected, the patch extraction unit **123** selects patches applied in common to the other virtual servers **2** among the respective patches applied thereto. In this case, the patches applied to the virtual server (**1**) are represented as "A B D E", and the patches applied to the virtual server (**2**) are represented as "A B C E", so that the patches A, B, and E are selected as the patches applied in common.

The patch extraction unit **123** excludes patches that are applied in advance to the virtual image from the selected patches. In this case, the patches A, B, and C are applied to the virtual image of the template 1, so that the patches A and B are excluded from the patches A, B, and E. This results in the selection of the patch E.

The patch extraction unit **123** extracts, among the selected patches, patches that are set to "Important" as the patch type, that have not been deleted on the other virtual servers **2**, and that are up to date but not just released, as patches to be applied. In this case, the selected patch E is extracted as a patch to be applied.

If any of the patches applied in advance to the virtual image have been deleted while the other virtual servers **2** are operating, the patch extraction unit **123** determines the deleted patches as application-canceled patches. In this case, the patch "C" is stored as the deleted patch **114***n* of the server information management DB **114**, so that the patch extraction unit **123** determines the patch C as an application-canceled patch.

As a result, the patch extraction unit **123** extracts the patch E as an optimal patch, and extracts the patch C as an application-canceled patch. Thereafter, the patch application unit **124** applies the patch E extracted as an optimal patch to the virtual server (**4**), and deletes the patch C extracted as an application-canceled patch from the virtual server (**4**).

Flowchart of Server Information Collection Process

An overall procedure of a server information collection process will be described with reference to FIG. **9**. FIG. **9** is a flowchart illustrating the overall procedure of the server information collection process according to the embodiment.

First, the server information collection unit **121** determines whether a collection request for server information has been issued (Step S**11**). If not (No at Step S**11**), the server information collection unit **121** repeats the determination process until the collection request for server information is issued.

If the collection request for server information has been issued (Yes at Step S**11**), the server information collection unit **121** performs the server information collection process (Step S**12**). For example, the server information collection unit **121** instructs all of the virtual servers **2** stored in the server information management DB **114** to collect the server information, and collects the server information from the virtual servers **2**. Thereafter, the server information collection unit **121** terminates the process.

A procedure of the server information collection process will be described with reference to FIG. **10**. FIG. **10** is a flowchart illustrating the procedure of the server information collection process according to the embodiment. The server information collection unit **121** is assumed to have received responses to the collection instruction of the server information issued to the virtual servers **2**.

After receiving the responses to the collection instruction of the server information from the virtual servers **2**, the server

information collection unit **121** selects one of all the virtual servers **2** stored in the server information management DB **114** (Step S**21**).

The server information collection unit **121** checks the operational status of the selected virtual server **2** (Step S**22**). For example, the server information collection unit **121** determines whether a response is received from the selected virtual server **2**. If so, the server information collection unit **121** determines that the selected virtual server **2** is in operation. If not, the server information collection unit **121** determines that the selected virtual server **2** is not in operation.

The server information collection unit **121** determines whether the selected virtual server **2** is in operation (Step S**23**). If not (No at Step S**23**), the server information collection unit **121** performs a process at Step S**27** to store information indicating that the selected virtual server **2** is not in operation. If the selected virtual server **2** is in operation (Yes at Step S**23**), the server information collection unit **121** performs the middleware operational status acquisition process (Step S**24**).

Next, the server information collection unit **121** acquires the information on the applied patches (Step S**25**). The server information collection unit **121** checks the difference in the patches (Step S**26**). For example, the server information collection unit **121** compares the information on the patches applied to the virtual image (template) corresponding to the selected virtual server **2** with the currently acquired information on the patches, and determines patches that have been added or deleted after the deployment. In addition, the server information collection unit **121** compares the previously acquired information on the patches with the currently acquired information on the patches, and determines patches that have been added or deleted after the previous acquisition.

The server information collection unit **121** registers the collected various types of information in the server information management DB **114** (Step S**27**). For example, when the virtual server **2** is not in operation, the server information collection unit **121** sets the information indicating that the virtual server **2** is not in operation in the server information management DB **114**. When the virtual server **2** is in operation, the server information collection unit **121** sets the operational status of the virtual server **2** in the server information management DB **114**. The server information collection unit **121** sets the operational status of the MW in the server information management DB **114**. The server information collection unit **121** sets the application status of the patches in the server information management DB **114**.

The server information collection unit **121** determines whether all of the virtual servers **2** have been selected (Step S**28**). If so (Yes at Step S**28**), the server information collection unit **121** terminates the process. If not (No at Step S**28**), the server information collection unit **121** selects the next virtual server **2** (Step S**29**), and performs the process at Step S**22**.

Procedure of Middleware Operational Status Acquisition Process

A procedure of the middleware (MW) operational status acquisition process will be described with reference to FIG. **11**. FIG. **11** is a flowchart illustrating the procedure of the middleware operational status acquisition process.

The server information collection unit **121** acquires installation information of the MW from the selected virtual server **2** (Step S**31**). For example, the server information collection unit **121** acquires the installation status and the installation destination of the MW from the selected virtual server **2**. The agent **24** collects the installation status and the installation destination of the MW from an area (registry or package information) that differs depending on the OS. If the server information collection unit **121** periodically collects the installation information of the MW, the server information collection unit **121** need not collect the installation information of the MW at this step.

The server information collection unit **121** acquires the log information on the services or processes that start the MW (Step S**32**). This is performed to obtain the operational status of the MW. The server information collection unit **121** compares the MW information of the template corresponding to the virtual server **2** with the currently collected MW information, and determines whether MW has been added or deleted after the deployment (Step S**33**). The term "MW information" here means the MW information **113***c* of the template corresponding to the virtual server **2** stored in the template management DB **113**, and the MW information for respective pieces of the MW corresponding to the virtual server **2** stored in the server information management DB **114**.

Next, the server information collection unit **121** selects one piece of the currently collected MW information (Step S**34**). Regarding the selected piece of the MW information, the server information collection unit **121** compares the currently collected log information with the previously collected log information, and determines the operational status of the MW (Step S**35**). For example, if the size of the currently collected log differs from the size of the previously collected log, the server information collection unit **121** determines that the piece of the MW is in operation. If the size of the currently collected log equals the size of the previously collected log, the server information collection unit **121** determines that the piece of the MW is not in operation.

The server information collection unit **121** determines whether all pieces of the currently collected MW information have been selected (Step S**36**). If so (Yes at Step S**36**), the server information collection unit **121** terminates the process. If not (No at Step S**36**), the server information collection unit **121** selects the next piece of MW information (Step S**37**), and performs the process at Step S**35**.

Overall Procedure of Virtual Server Deployment Process

An overall procedure of the virtual server deployment process will be described with reference to FIG. **12**. FIG. **12** is a flowchart illustrating the overall procedure of the virtual server deployment process according to the embodiment.

First, selection of a virtual image (template) by the user causes the virtual server deployment unit **122** to use the selected virtual image to deploy a virtual server **2** (Step S**41**). Then, the patch extraction unit **123** performs the patch extraction process for the deployed virtual server **2** (Step S**42**). Thereafter, the patch application unit **124** performs the patch application process to apply the extracted patches to the deployed virtual server **2** (Step S**43**).

Procedure of Patch Extraction Process

A procedure of the patch extraction process will be described with reference to FIG. **13**. FIG. **13** is a flowchart illustrating the procedure of the patch extraction process.

First, the patch extraction unit **123** performs the patch extraction process from virtual servers **2** that have an identical configuration to that of the deployed virtual server **2** (Step S**51**). Next, if no virtual servers **2** exist that have an identical configuration to that of the deployed virtual server **2**, the patch extraction unit **123** performs the patch extraction process from virtual servers **2** that have similar configurations to that of the deployed virtual server **2** (Step S**52**). Then, the patch extraction unit **123** extracts deleted patches to be deleted from the patches extracted by the patch extraction process (Step S**53**).

Procedure of Patch Extraction Process from Identically Configured Servers

A procedure of the patch extraction process from the identically configured servers will be described with reference to FIG. **14**. FIG. **14** is a flowchart illustrating the procedure of the patch extraction process from the identically configured servers.

First, the patch extraction unit **123** acquires the template, the use, and the information on the MW of the deployed virtual server **2** at the time of deployment (Step S**61**). Then, with reference to the server information management DB **114**, the patch extraction unit **123** selects virtual servers **2** on which the template, the OS, the use, and the MW used are the same as those acquired (Step S**62**). The patch extraction unit **123** lists the selected other virtual servers **2** in the server list data **115**.

The patch extraction unit **123** excludes virtual servers **2** that have not been operating for the last n months from the selected virtual servers **2** (Step S**63**). For example, with reference to the last check date of the operation record **114***e* in the server information management DB **114**, the patch extraction unit **123** deletes the virtual servers **2** that have not been operating for the last n months from the virtual servers **2** listed in the server list data **115**.

In addition, the patch extraction unit **123** excludes virtual servers **2** to which no patch has been applied for the last n months from the selected virtual servers **2** (Step S**64**). For example, with reference to the last patch application date **1141** of the server information management DB **114**, the patch extraction unit **123** deletes the virtual servers **2** to which no patch has been applied for the last n months from the virtual servers **2** listed in the server list data **115**.

Then, with reference to the server list data **115**, the patch extraction unit **123** determines whether virtual servers **2** have been selected (Step S**65**). If not (No at Step S**65**), the patch extraction unit **123** terminates the process.

If virtual servers **2** have been selected (Yes at Step S**65**), the patch extraction unit **123** extracts a logical product of patches already applied to the selected virtual servers **2**, with reference to the server information management DB **114** (Step S**66**). In other words, when a plurality of virtual servers **2** have been selected, the patch extraction unit **123** extracts patches applied in common to the selected virtual servers **2** among the respective patches applied thereto.

Then, the patch extraction unit **123** excludes the patches already applied to the template of the deployed virtual server **2** at the time of deployment from the list of the extracted patches, and adds the result to the optimal patch list data **116** (Step S**67**). Furthermore, with reference to the server information management DB **114**, the patch extraction unit **123** extracts a logical sum of the patches already applied to the selected virtual servers **2** (Step S**68**). In other words, the patch extraction unit **123** extracts the patches applied to any of the virtual servers **2**. Then, the patch extraction unit **123** excludes the patches extracted as the logical product from the list of the patches extracted as the logical sum (Step S**69**).

Next, the patch extraction unit **123** selects one patch from the list of the patches extracted as the logical sum (Step S**70**). With reference to the patch management DB **111**, the patch extraction unit **123** determines whether the type of the selected patch is "Important" (Step S**71**). If not (No at Step S**71**), the patch extraction unit **123** performs a process at Step S**76** to select the next patch to be extracted.

If the type of the selected patch is "Important" (Yes at Step S**71**), the patch extraction unit **123** determines whether the selected patch has ever been deleted (Step S**72**). If the selected patch has ever been deleted, applying the selected patch can have an influence on the operation of jobs. This determination is made to preclude application of such a patch. For example, with reference to the deleted patch **114***n* of the server information management DB **114**, the patch extraction unit **123** determines whether the selected patch is included in the deleted patches.

If the selected patch has ever been deleted (Yes at Step S**72**), the patch extraction unit **123** performs the process at Step S**76** to select the next patch to be extracted.

If not (No at Step S**72**), the patch extraction unit **123** determines whether the operating rate of the virtual server **2** to which the selected patch is applied is x % or less (Step S**73**). If the operating rate of the virtual server **2** to which the selected patch is applied is x % or less, applying the selected patch can have an influence on the operation of jobs. This determination is made to preclude application of such a patch. For example, with reference to the operating rate **114***f* of the server information management DB **114**, the patch extraction unit **123** determines whether the operating rate of the virtual server **2** to which the selected patch is applied is x % or less.

If so (Yes at Step S**73**), the patch extraction unit **123** performs the process at Step S**76** to select the next patch to be extracted.

If the operating rate of the virtual server **2** to which the selected patch is applied is not x % or less (No at Step S**73**), the patch extraction unit **123** determines whether less than n months have elapsed from the latest release date of the selected patch (Step S**74**). If less than n months have elapsed from the latest release date of the selected patch, applying the selected patch can have an influence on the operation of jobs. This determination is made to preclude application of such a patch. For example, with reference to the release date **111***e* of the patch management DB **111**, the patch extraction unit **123** determines whether less than n months have elapsed from the release date of the selected patch.

If so (Yes at Step S**74**), the patch extraction unit **123** performs the process at Step S**76** to select the next patch to be extracted. If not (No at Step S**74**), the patch extraction unit **123** adds the selected patch to the optimal patch list data **116** (Step S**75**).

The patch extraction unit **123** determines whether all patches have been selected from the list of the patches extracted as the logical sum (Step S**76**). If so (Yes at Step S**76**), the patch extraction unit **123** terminates the process. If not (No at Step S**76**), the patch extraction unit **123** selects the next patch from the list of the patches (Step S**77**), and performs the process at Step S**71**.

Procedure of Patch Extraction Process from Similarly Configured Servers

A procedure of the patch extraction process from the similarly configured servers will be described with reference to FIG. **15**. FIG. **15** is a flowchart illustrating the procedure of the patch extraction process from the similarly configured servers.

First, the patch extraction unit **123** acquires the template, the use, and the information on the MW of the deployed virtual server **2** at the time of deployment (Step S**81**). Then, the patch extraction unit **123** selects one piece of the deployed MW from the template (Step S**82**). With reference to the server information management DB **114**, the patch extraction unit **123** selects virtual servers **2** on which the OS and the use are the same as those acquired, and on which the selected piece of the MW is in operation (Step S**83**). The patch extraction unit **123** lists the selected other virtual servers **2** in the server list data **115**.

The patch extraction unit **123** excludes virtual servers **2** that have not been operating for the last n months from the

selected virtual servers **2** (Step S**84**). For example, with reference to the last check date of the operation record **114***e* in the server information management DB **114**, the patch extraction unit **123** deletes the virtual servers **2** that have not been operating for the last n months from the virtual servers **2** listed in the server list data **115**.

In addition, the patch extraction unit **123** excludes virtual servers **2** to which no patch has been applied for the last n months from the selected virtual servers **2** (Step S**85**). For example, with reference to the last patch application date **114***l* of the server information management DB **114**, the patch extraction unit **123** deletes the virtual servers **2** to which no patch has been applied for the last n months from the virtual servers **2** listed in the server list data **115**.

With reference to the server information management DB **114**, the patch extraction unit **123** extracts a logical product of patches already applied to the selected virtual servers **2** (Step S**86**). In other words, when a plurality of virtual servers **2** have been selected, the patch extraction unit **123** extracts patches applied in common to the selected virtual servers **2** among the respective patches applied thereto.

Then, the patch extraction unit **123** excludes the patches already applied to the template of the deployed virtual server **2** at the time of deployment from the list of the extracted patches (Step S**87**). The patch extraction unit **123** determines whether all pieces of the deployed MW have been selected from the template (Step S**88**). If not (No at Step S**88**), the patch extraction unit **123** selects the next piece of the MW from the template (Step S**89**), and performs the process at Step S**83**.

If all pieces of the deployed MW have been selected (Yes at S**88**), the patch extraction unit **123** selects one patch from the list of the extracted patches (Step S**90**). With reference to the patch management DB **111**, the patch extraction unit **123** determines whether the type of the selected patch is "Important" (Step S**91**). If not (No at Step S**91**), the patch extraction unit **123** performs a process at Step S**95** to select the next patch to be extracted.

If the type of the selected patch is "Important" (Yes at Step S**91**), the patch extraction unit **123** determines whether the selected patch has ever been deleted (Step S**92**). If the selected patch has ever been deleted, applying the selected patch can have an influence on the operation of jobs. This determination is made to preclude application of such a patch. For example, with reference to the deleted patch **114***n* of the server information management DB **114**, the patch extraction unit **123** determines whether the selected patch is included in the deleted patches.

If the selected patch has ever been deleted (Yes at Step S**92**), the patch extraction unit **123** performs a process at Step S**95** to select the next patch to be extracted.

If not (No at Step S**92**), the patch extraction unit **123** determines whether less than n months have elapsed from the latest release date of the selected patch (Step S**93**). If less than n months have elapsed from the latest release date of the selected patch, applying the selected patch can have an influence on the operation of jobs. This determination is made to preclude application of such a patch. For example, with reference to the release date **111***e* of the patch management DB **111**, the patch extraction unit **123** determines whether less than n months have elapsed from the release date of the selected patch.

If so (Yes at Step S**93**), the patch extraction unit **123** performs the process at Step S**95** to select the next patch to be extracted. If not (No at Step S**93**), the patch extraction unit **123** adds the selected patch to the optimal patch list data **116** (Step S**94**).

The patch extraction unit **123** determines whether all patches have been selected from the list of the extracted patches (Step S**95**). If so (Yes at Step S**95**), the patch extraction unit **123** terminates the process. If not (No at Step S**95**), the patch extraction unit **123** selects the next patch from the list of the extracted patches (Step S**96**), and performs the process at Step S**91**.

Procedure of Deleted Patch Extraction Process

A procedure of the deleted patch extraction process will be described with reference to FIG. **16**. FIG. **16** is a flowchart illustrating the procedure of the deleted patch extraction process.

With reference to the server information management DB **114**, the patch extraction unit **123** extracts a logical sum of the patches already deleted from the selected virtual servers **2** (Step S**101**). The patch extraction unit **123** selects one patch from the list of the extracted patches (Step S**102**). The patch extraction unit **123** determines whether the selected patch is included among the already applied patches of the template at the time of deployment (Step S**103**). For example, with reference to the template management DB **113**, the patch extraction unit **123** determines whether the selected patch is included in the applied patch **113***g* at the time of deployment.

If not (No at Step S**103**), the patch extraction unit **123** performs a process at Step S**105** to select the next patch to be extracted. If the selected patch is included among the already applied patches of the template at the time of deployment (Yes at Step S**103**), the patch extraction unit **123** registers the selected patch as a deleted patch in the optimal patch list data **116** (Step S**104**).

The patch extraction unit **123** determines whether all patches have been selected from the list of the extracted patches (Step S**105**). If so (Yes at Step S**105**), the patch extraction unit **123** terminates the process. If not (No at Step S**105**), the patch extraction unit **123** selects the next patch from the list of the extracted patches (Step S**106**), and performs the process at Step S**103**.

Effects of Embodiment

According to the above-described embodiment, the management server **1** includes the server information management DB **114** that stores therein the information on the virtual servers **2** deployed from the virtual images and the information on the software that runs on the virtual servers **2**, on a server-by-server basis. The management server **1** refers to the server information management DB **114**, and, based on the information on a particular virtual machine deployed from a predetermined virtual image and the information on the software that runs on the particular virtual machine, selects other virtual machines. Based on the details about patches applied to the selected other virtual machines, the management server **1** extracts patches to be applied to the particular virtual machine. This configuration allows the management server **1** to determine whether the patches to be applied to the particular virtual machine can be applied thereto, and thus to extract optimal patches.

According to the above-described embodiment, the server information management DB **114** stores therein the information including the uses and the operation records of the virtual servers **2** as the information on the virtual servers **2**, and also stores therein the information including the OSs and the middleware as the information on the software that runs on the virtual servers. With reference to the server information management DB **114**, the management server **1** selects other virtual servers that are the same as the particular virtual server **2** in terms of the use, the OS, and the configuration of the

middleware. When more than one of the other virtual servers **2** has been selected, the management server **1** extracts common patches as patches to be applied to the particular virtual server **2** among the respective patches applied to the other virtual servers **2**. In addition, the management server **1** selects patches applied to any of the other virtual servers **2**, and, based on the details about the selected patches, further extracts patches to be applied to the particular virtual server **2**. This configuration causes the management server **1** to extract the patches to be applied to the particular virtual server **2** from the other virtual servers **2** that are the same as the particular virtual server **2** in terms of the use, the OS, and the configuration of the middleware, and thereby allows the management server **1** to apply optimal patches to the particular virtual server **2**. The management server **1** also extracts the patches to be applied to the particular virtual server **2** from the other virtual servers **2** that are the same as the particular virtual server **2** in terms of the use, and thereby can select patches taking a difference in use into account.

According to the above-described embodiment, when the management server **1** has not succeeded in selecting the other virtual servers **2** that are the same as the particular virtual server **2** in terms of the use, the OS, and the configuration of the middleware, the management server **1** performs the following process. That is, with reference to the server information management DB **114**, the management server **1** selects other virtual servers **2** that are the same as the particular virtual server **2** in terms of the OS, the use, and any piece of the middleware. For each piece of the middleware deployed to the particular virtual server **2**, when more than one other virtual server **2** exists that has the same piece of the middleware as the piece of the deployed middleware, the management server **1** selects common patches among the respective patches applied to the other virtual servers **2**. Based on the details about the selected patches, the management server **1** extracts patches to be applied to the particular virtual server **2**. This configuration causes the management server **1** to extract the patches to be applied to the particular virtual server **2** from the other virtual servers **2** that are not the same as the particular virtual server **2** in terms of the use, the OS, and the configuration of the operating middleware but have the same piece of the middleware as the piece of the middleware deployed to the particular virtual server **2**. Thus, this configuration allows the management server **1** to apply optimal patches to the particular virtual server **2**.

According to the above-described embodiment, when the details about a selected patch indicate that the patch is most important, has not been deleted on any of the other virtual servers **2**, and is up to date, the management server **1** extracts the patch as a patch to be applied to the particular virtual server **2**. This configuration allows the management server **1** to smoothly perform the operation in jobs by applying the extracted patches.

According to the above-described embodiment, when each of the other virtual servers **2** to which a selected patch is applied has operated at more than a predetermined operating rate, the management server **1** extracts the patch as a patch to be applied to the particular virtual server **2**. This configuration allows the management server **1** to extract patches that do not affect the operation by being applied.

Other

The agent **24** has been described as collecting the log information on the services or processes that start the MW. This log information is collected to allow the server information collection unit **121** to determine the operational status of the MW. However, not limited to this, the agent **24** may collect configuration information of files generated by the services or processes that start the MW, for the same purpose. The server information collection unit **121** only needs to compare the currently collected configuration information of files generated by the services or processes that start the MW with the previously collected configuration information of files generated by the services or processes that start the same MW, and determine the operational status of the MW. Specifically, if the previously collected configuration information of files corresponding to the MW differs from the previously collected configuration information of files corresponding to the same MW, the server information collection unit **121** determines that the MW is in operation. If the previously collected configuration information of files corresponding to the MW does not differ from the previously collected configuration information of files corresponding to the same MW, the server information collection unit **121** determines that the MW is not in operation.

The management server **1** can be implemented by providing the above-described functions, such as the server information collection unit **121**, the virtual server deployment unit **122**, and the patch extraction unit **123**, on a known information processing apparatus, such as a personal computer or a workstation.

The components of the illustrated devices are not necessarily needed to be physically configured as illustrated in the drawings. In other words, the specific mode of distribution and integration of the devices is not limited to those illustrated in the drawings, and all or a part thereof can be functionally or physically distributed or integrated in any desired unit according to various types of load and the status of use. For example, the patch extraction unit **123** and the patch application unit **124** may be integrated as one unit. The patch extraction unit **123** may be divided into a first patch extraction unit for extracting patches from the virtual servers **2** that have an identical configuration and a second patch extraction unit for extracting patches from the virtual servers **2** that have similar configurations. The patch management DB **111**, the media library **112**, the template management DB **113**, and the server information management DB **114** may be connected as external devices to the management server **1** via a network.

The various processes described in the embodiment above can be carried out by executing a prepared program on a computer, such as a personal computer or a workstation. A description will be made below of a computer that executes the patch extraction program implementing the same functions as those of the management server **1** illustrated in FIG. **1**. FIG. **17** is a diagram illustrating an example of the computer that executes the patch extraction program.

As illustrated in FIG. **17**, this computer **200** has a CPU **203** that performs various types of arithmetic processing, an input device **215** that accepts input of data from the user, and a display control unit **207** that controls a display device **209**. The computer **200** also has a drive device **213** that reads, for example, the program from a storage medium, and a communication control unit **217** that sends and receives data to and from other computers via a network. The computer **200** also has a memory **201** and an HDD **205** that temporarily store therein various types of information. The memory **201**, the CPU **203**, the HDD **205**, the display control unit **207**, the drive device **213**, the input device **215**, and the communication control unit **217** are connected to each other via a bus **219**.

The drive device **213** is a device for, for example, a removable disk **211**. The HDD **205** stores therein a patch extraction program **205***a* and patch extraction-related information **205***b*.

The CPU **203** reads the patch extraction program **205***a*, loads the program into the memory **201**, and executes it as processes. The processes correspond to the functional units of

the management server **1**. The patch extraction-related information **205***b* corresponds to the patch management DB **111**, the media library **112**, the template management DB **113**, the server information management DB **114**, the server list data **115**, and the optimal patch list data **116**. For example, the removable disk **211** stores therein the respective pieces of information, such as the patch extraction program **205***a*.

The patch extraction program **205***a* need not be stored in the HDD **205** from the beginning. For example, the program may be stored in a "portable physical medium," such as a flexible disk (FD), a CD-ROM, a DVD, a magneto-optical disc, and an integrated circuit card. The computer **200** may read the patch extraction program **205***a* from the portable physical medium, and execute the program.

According to an aspect of the present invention, a patch can appropriately be selected.

All examples and conditional language recited herein are intended for pedagogical purposes of aiding the reader in understanding the invention and the concepts contributed by the inventor to further the art, and are not to be construed as limitations to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although the embodiment of the present invention has been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A non-transitory computer-readable recording medium storing therein a software correction patch extraction program that causes a computer to execute a process comprising:

referring to a storage unit that stores therein information on a plurality of virtual machines generated from a plurality of virtual images and information on software that operates on each of the plurality of virtual machines;

selecting another virtual machine that is the same as a particular virtual machine in terms of a use, an operating system (OS), and a piece of a middleware from the plurality of virtual machines based on information on the particular virtual machine generated from a certain virtual image and information on software that operates on the particular virtual machine; and

extracting a software correction patch to be applied to the particular virtual machine based on a software correction patch applied to the another virtual machine selected at the selecting.

2. The non-transitory computer-readable recording medium according to claim **1**, wherein

the storage unit stores therein information including uses and operation records of the plurality of virtual machines as the information on the plurality of virtual machines and information including OSs and middleware as the information on the software that operates on each of the plurality of virtual machines;

the selecting, with reference to the storage unit, selects the another virtual machine that is the same as the particular virtual machine in terms of the use, the OS, and a configuration of the middleware; and

the extracting extracts, when a plurality of other virtual machines selected at the selecting exist, a common software correction patch as a software correction patch to be applied to the particular virtual machine among software correction patches applied to the plurality of other virtual machines, and selects a software correction patch applied to any of the plurality of other virtual machines, and further extracts a software correction patch to be applied to the particular virtual machine based on details about the selected software correction patch.

3. The non-transitory computer-readable recording medium according to claim **2**, wherein

the selecting selects the another virtual machine that is the same as the particular virtual machine in terms of the use, the OS, and any piece of the middleware, with reference to the storage unit when the selecting does not select the another virtual machine that is the same as the particular virtual machine in terms of the use, the OS, and the configuration of the middleware; and

for each piece of the middleware that operates on the particular virtual machine, when a plurality of other virtual machines that have the same piece of the middleware as that of the particular virtual machine exist, the extracting selects a common software correction patch among software correction patches applied to the plurality of other virtual machines, and extracts a software correction patch to be applied to the particular virtual machine based on the details about the selected software correction patch.

4. The non-transitory computer-readable recording medium according to claim **2**, wherein, when the details about the selected software correction patch indicate that the selected software correction patch is set to important as a patch type, has not been deleted on any of the plurality of other virtual machines, and is up to date, the extracting extracts the selected software correction patch as a software correction patch to be applied to the particular virtual machine.

5. The non-transitory computer-readable recording medium according to claim **4**, wherein, when each of the plurality of other virtual machines to which the selected software correction patch is applied has operated at more than a certain operating rate, the extracting extracts the selected software correction patch as a software correction patch to be applied to the particular virtual machine.

6. The non-transitory computer-readable recording medium according to claim **4**, wherein, when the selected software correction patch is up to date but not just released, the extracting extracts the selected software correction patch as a software correction patch to be applied to the particular virtual machine.

7. A method for extracting a software correction patch on a computer, the method comprising:

referring to a storage unit that stores therein information on a plurality of virtual machines generated from a plurality of virtual images and information on software that operates on each of the plurality of virtual machines using a processor;

selecting another virtual machine that is the same as a particular virtual machine in terms of a use, an operating system (OS), and a piece of a middleware from the plurality of virtual machines based on information on the particular virtual machine generated from a certain virtual image and information on software that operates on the particular virtual machine using the processor; and

extracting a software correction patch to be applied to the particular virtual machine based on a software correction patch applied to the another virtual machine selected at the selecting using the processor.

8. An information processing apparatus comprising:

a processor; and

a storage unit that stores therein information on a plurality of virtual machines generated from a plurality of virtual images and information on software that operates on

each of the plurality of virtual machines, wherein the processor executes a process comprising:

referring to the information on the plurality of virtual machines and the information on the software that operates on each of the plurality of virtual machines stored in the storage unit;

selecting another virtual machine that is the same as a particular virtual machine in terms of a use, an operating system (OS), and a piece of a middleware from the plurality of virtual machines based on information on the particular virtual machine generated from a certain virtual image and information on software that operates on the particular virtual machine; and

extracting a software correction patch to be applied to the particular virtual machine based on a software correction patch applied to the another virtual machine selected at the selecting.

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